I-7013, I-7015, I-7033, M-7015 and M-7033 Series User Manual

Warranty

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Date: 2011/9/16

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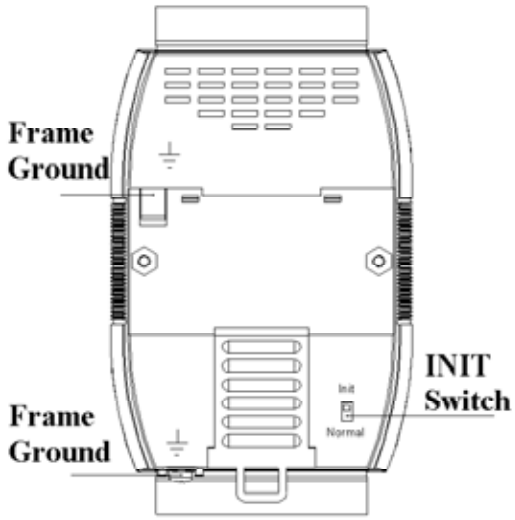
1. Introduction

The I-7000 series is a family of network data acquisition and control modules, providing analog-to-digital, digital-to-analog, digital input/output, timer/counter and other functions. The modules can be remotely controlled using a set of commands, which we call the DCON protocol. Communication between the module and the host is in ASCII format via an RS-485 bi-directional serial bus standard. Baud Rates are software programmable and transmission speeds of up to 115.2 Kbps can be selected.

The functionality of the M-7000 series is the same as the I-7000 series, with the exception that the M-7000 series offers extended support for the Modbus RTU protocol.

Some I-7000 modules feature a new design for the frame ground and INIT switch as shown in the figure (rear view). The frame ground provides enhanced static protection (ESD) abilities and ensures the module is more reliable. The INIT switch allows easier access to INIT mode. Please refer to Sections A.1 and A.3 for more details.



The common features of the I-7013/13D, I-7033/33D, I-7015/15P, M-7015/15P, and M-7033/33D modules are as follows:

1. 3000V DC inter-module isolation

2. 24-bit sigma-delta ADC to provide excellent accuracy
3. Direct RTD (resistance temperature detector) connection
4. Software calibration

The I-7013 is a single channel RTD input module. The I-7013D is the I-7013 with a 4 1/2 digit LED display. The I-7015/M-7015 is a 6-channel RTD input module. The I-7015P/M-7015P is a 6-channel RTD input module with lead resistances elimination. The I-7033/M-7033 is a 3-channel RTD input module. The I-7033D/M-7033D is the I-7033/M-7033 with a 4 1/2 digit LED display.

Supported RTD types are as follows:

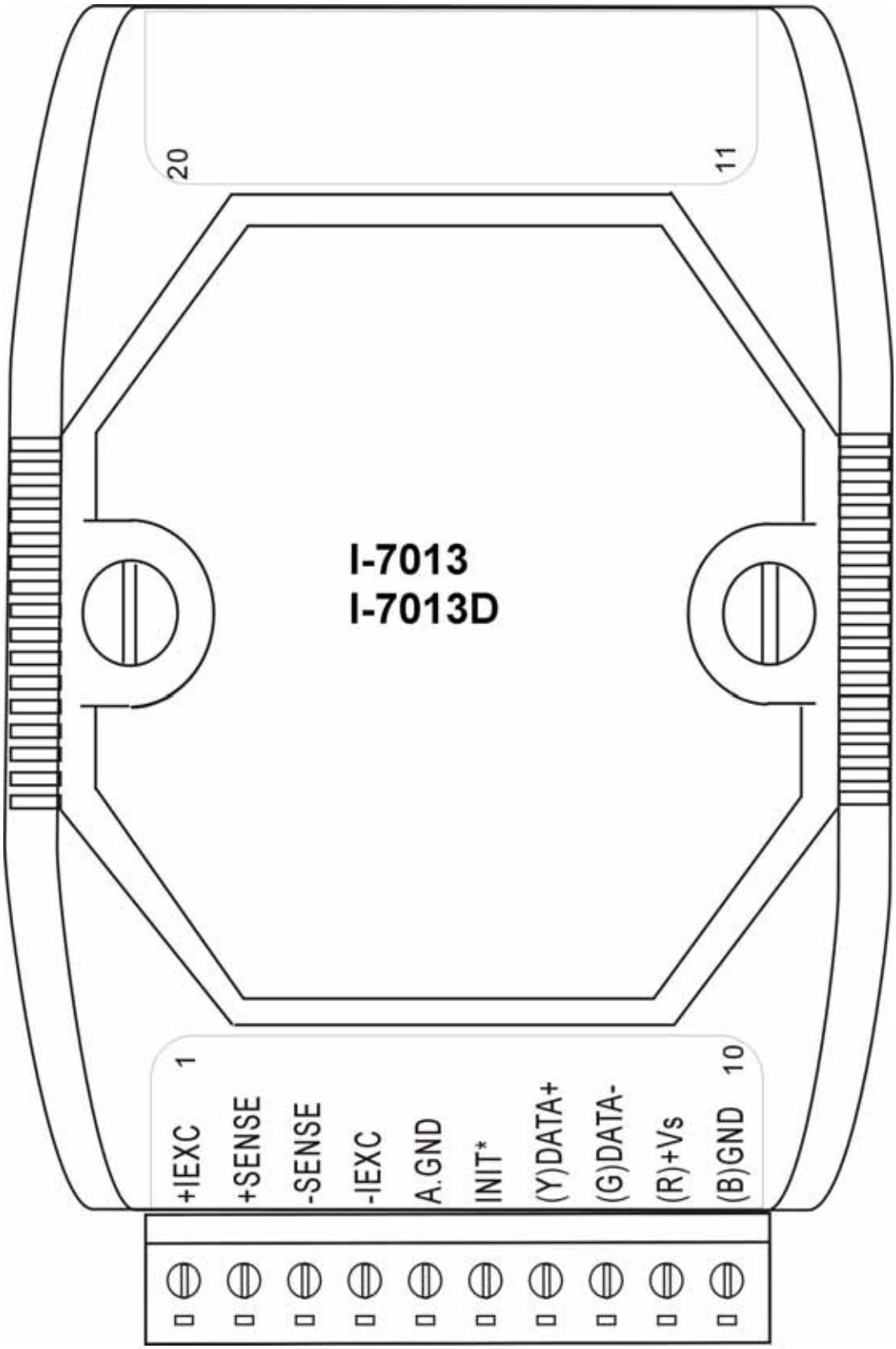
1. Platinum, 100 Ohms at 0°C, $\alpha = 0.00385$
2. Platinum, 100 Ohms at 0°C, $\alpha = 0.003916$
3. Platinum, 1000 Ohms at 0°C, $\alpha = 0.00385$ (I-7013/13D firmware version B1.3 and later, I-7033/33D, M-7033/33D, I-7015/15P and M-7015/15P)
4. Nickel, 120 Ohms at 0°C, $\alpha = 0.00672$
5. Copper, 100 Ohms at 0°C, $\alpha = 0.00421$ (I-7015/15P and M-7015/15P)
6. Copper, 1000 Ohms at 0°C, $\alpha = 0.00421$ (I-7015/15P and M-7015/15P)
7. Copper, 100 Ohms at 25°C, $\alpha = 0.00427$ (I-7015/15P and M-7015/15P)
8. Copper, 50 Ohms at 0°C, (I-7015/15P and M-7015/15P firmware version A2.3 and later)
9. Nickel, 100 Ohms at 0°C, (I-7015/15P and M-7015/15P firmware version A2.9 and later)

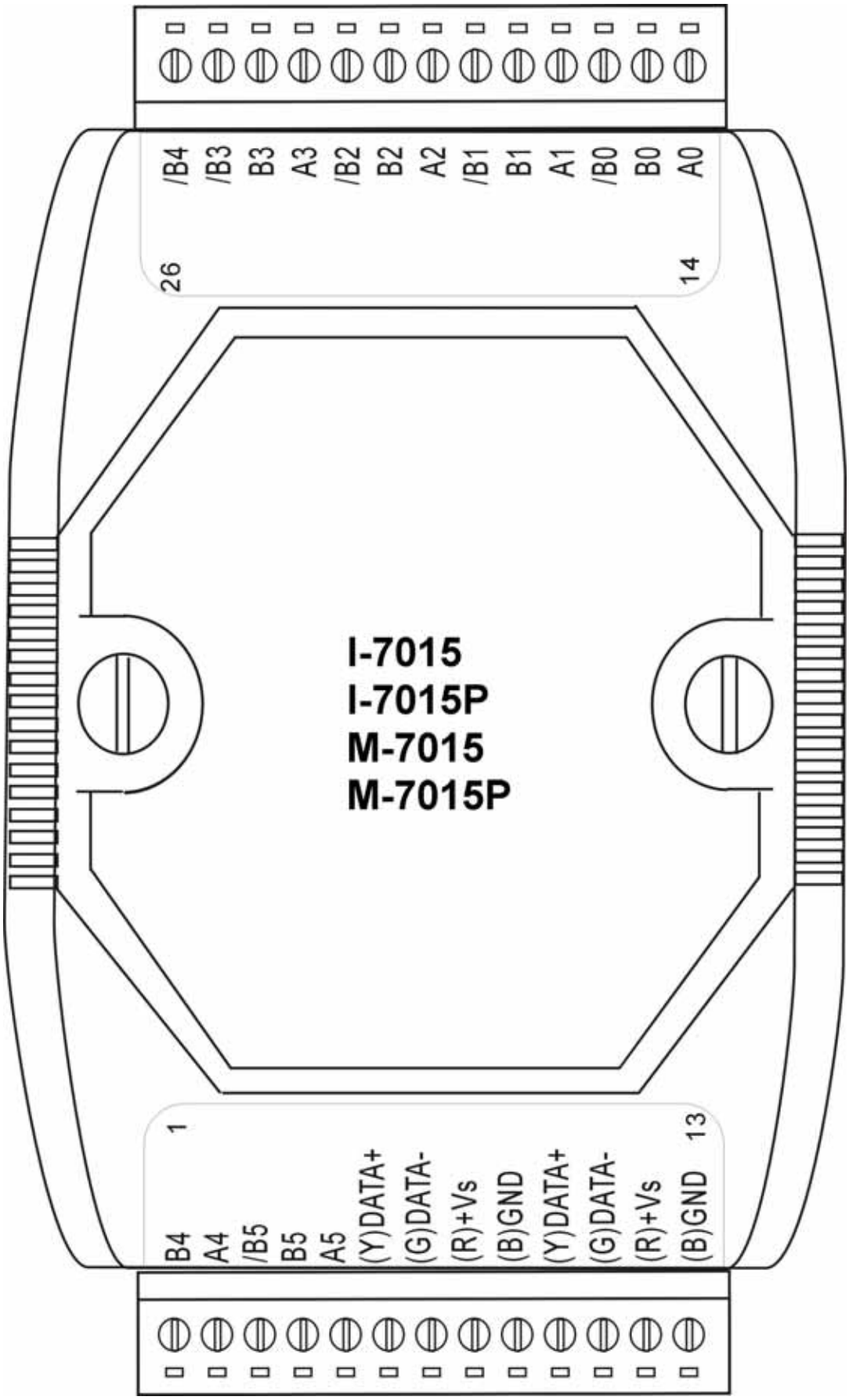
1.1 More Information

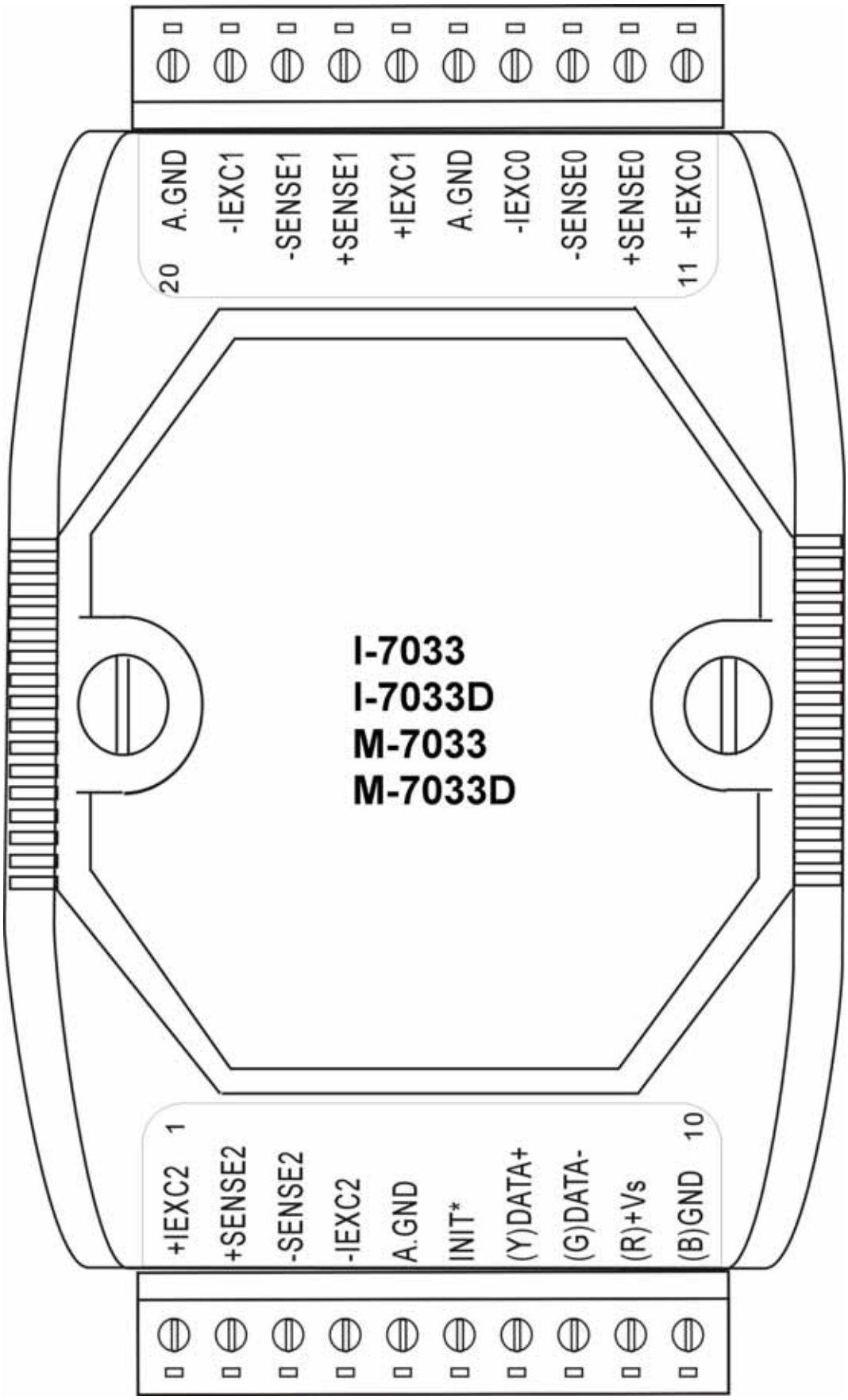
For more information regarding the I-7000 series, please refer to chapter 1 of the “I-7000 Bus Converter User Manual” as shown below or visit the ICP DAS website http://www.icpdas.com.

1.1 The 7000 Series Overview
1.2 Related Documentation for the 7000 Series
1.3 Common Features of the 7000 Series
1.4 The 7000 Series System Network Configuration
1.5 7000 Dimensions

1.2 Terminal Assignment




/B4
/B3
B3
A3
/B2
B2
A2
/B1
B1
A1
/B0
B0
A0
26
14
I-7015
I-7015P
M-7015
M-7015P
1
B4
A4
/B5
B5
A5
(Y)DATA+
(G)DATA-
(R)+Vs
(B)GND
(Y)DATA+
(G)DATA-
(R)+Vs
(B)GND
13


20 A.GND
-IEXC1
-SENSE1
+SENSE1
+IEXC1
A.GND
-IEXC0
-SENSE0
+SENSE0
11 +IEXC0
I-7033
I-7033D
M-7033
M-7033D
+IEXC2 1
+SENSE2
-SENSE2
-IEXC2
A.GND
INIT*
(Y)DATA+
(G)DATA-
(R)+Vs
(B)GND 10

1.3 Specifications

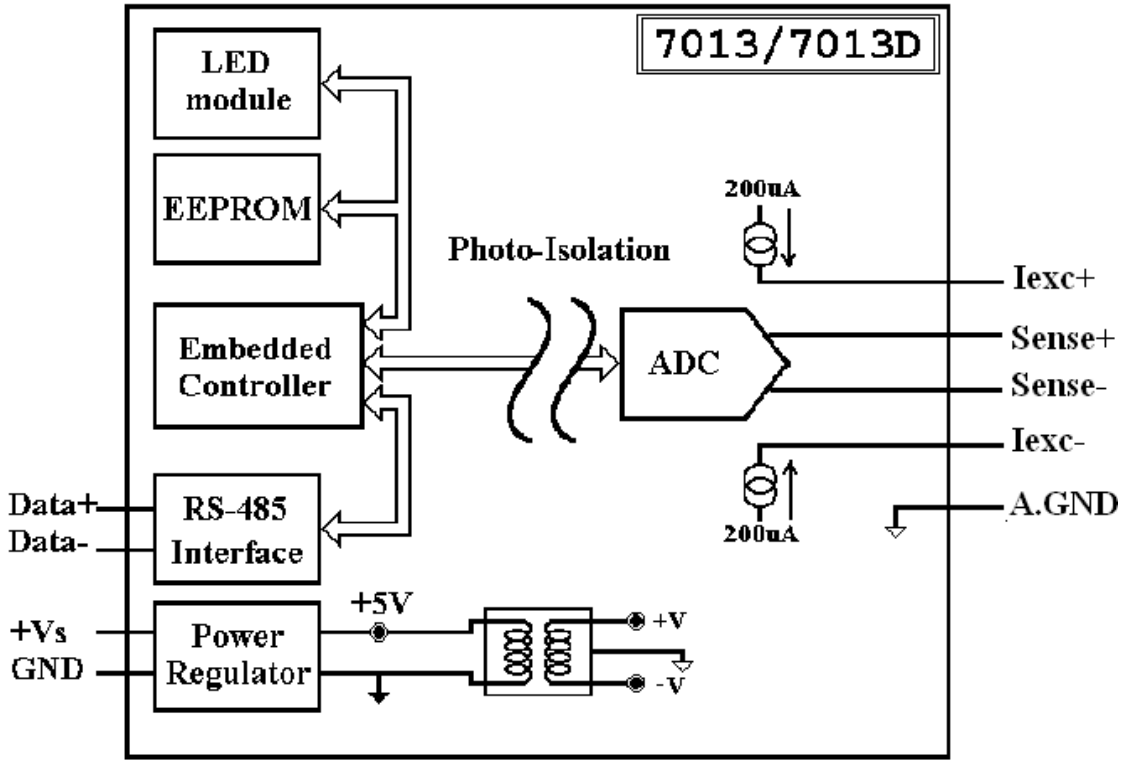
	I-7013/I-7013D	I-7033/I-7033D M-7033/M-7033D	I-7015/I-7015P M-7015/M-7015P
Analog Input			
Input Channels	1	3	6
Input Type	2/3/4-wire RTD	2/3/4-wire RTD	2/3-wire RTD
RTD Type	Pt100 α = 0.00385 Pt100 α = 0.003916 Ni120 Pt1000 α = 0.00385 (for firmware version B1.3 and later)	Pt100 α = 0.00385 Pt100 α = 0.003916 Ni120 Pt1000 α = 0.00385	Pt100 α = 0.00385 Pt100 α = 0.003916 Ni120 Pt1000 α = 0.00385 Cu100 α = 0.00421 Cu100 α = 0.00427 Cu1000 α = 0.00421
Sampling Rate	10 samples/sec	15 samples/sec at 60Hz 12.5 samples/sec at 50Hz	12 samples/sec
Bandwidth	5.24 Hz	15.7 Hz	5.24 Hz
Accuracy	±0.05%	±0.1%	±0.05%
Zero Drift	0.5 μV/°C	0.5 μV/°C	0.5 μV/°C
Span Drift	20 μV/°C	20 μV/°C	20 μV/°C
CMR@50/60Hz	150 dB min	150 dB min	150 dB min
NMR@50/60Hz	100 dB min	100 dB min	100 dB min
Isolation	3000 VDC	3000 VDC	3000 VDC
Modbus RTU		M-7033/M-7033D	M-7015/M-7015P
LED Display	4 1/2 digits (for I-7013D only)	4 1/2 digits (for I-7033D and M-7033D only)	
Power			
Requirements	+10 to +30 VDC	+10 to +30 VDC	+10 to +30 VDC
Consumption	0.7 W for I-7013 1.3 W for I-7013D	1.0 W for I-7033/M-7033 1.6 W for I-7033D/ M-7033D	1.1 W
Temperature Range			
Operating	-25°C to +75°C	-25°C to +75°C	-25°C to +75°C
Storage	-30°C to +75°C	-30°C to +75°C	-30°C to +75°C

Notes:

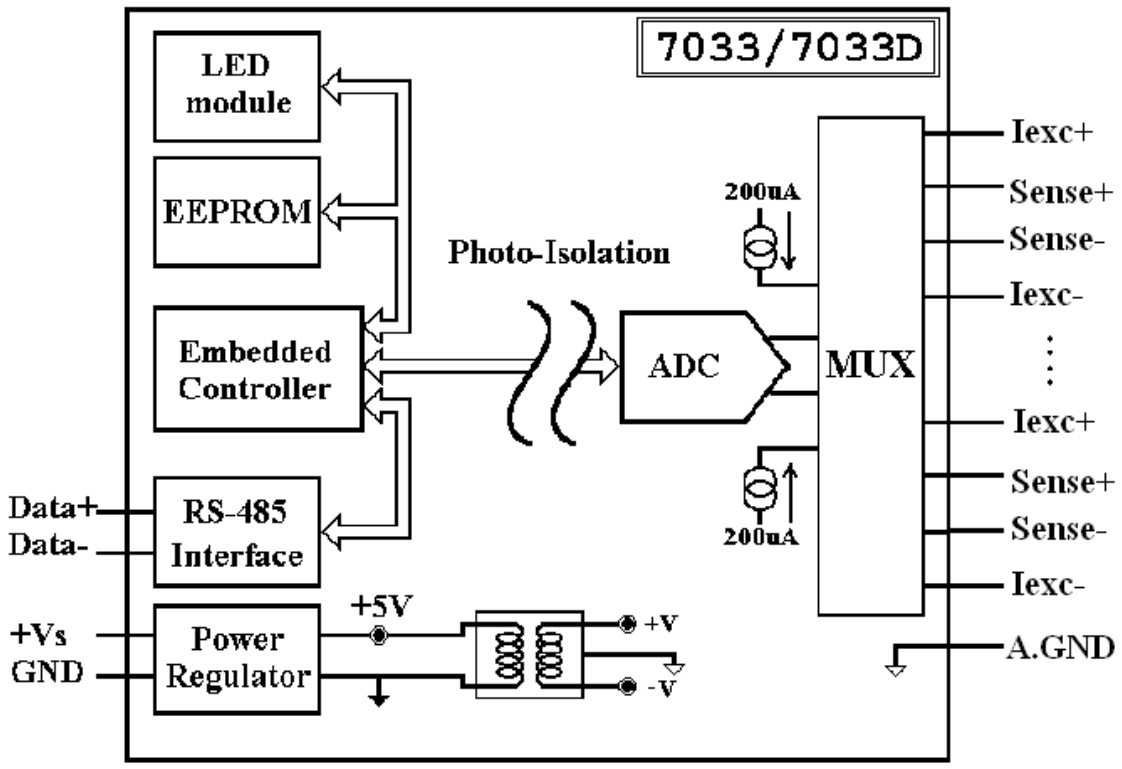
1. A warm up period of 30 minutes is recommended in order to achieve the complete performance results described in the specifications.
2. The specifications are typical at 25°C unless otherwise stated.

1.4 Block Diagrams

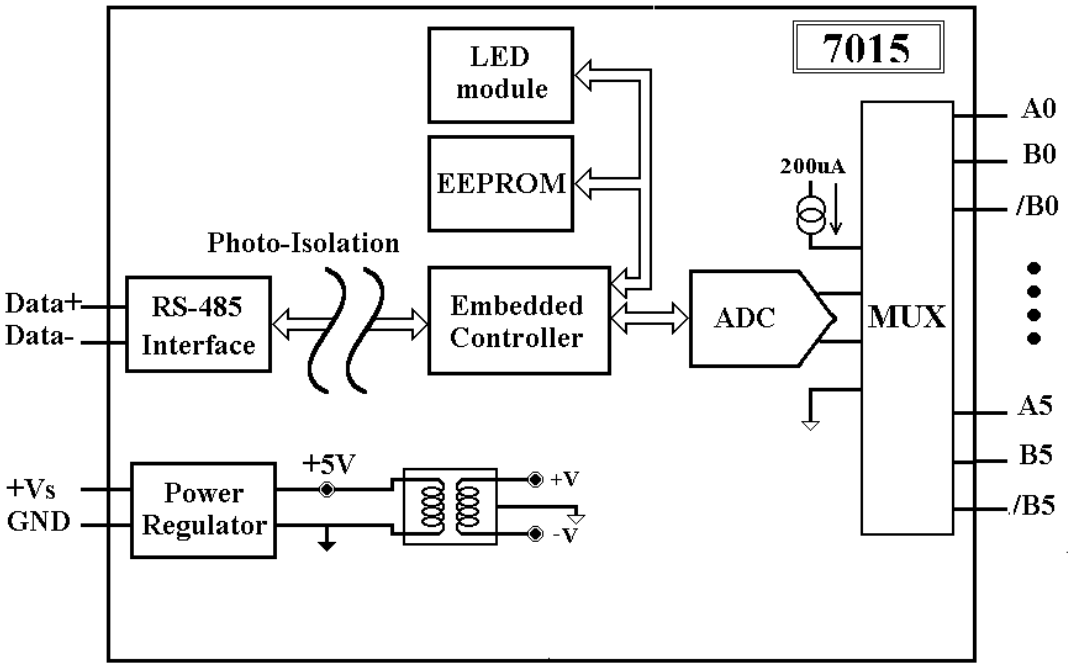
1.4.1 Block Diagram for the I-7013 and I-7013D



1.4.2 Block Diagram for the I-7033, I-7033D, M-7033 and M-7033D

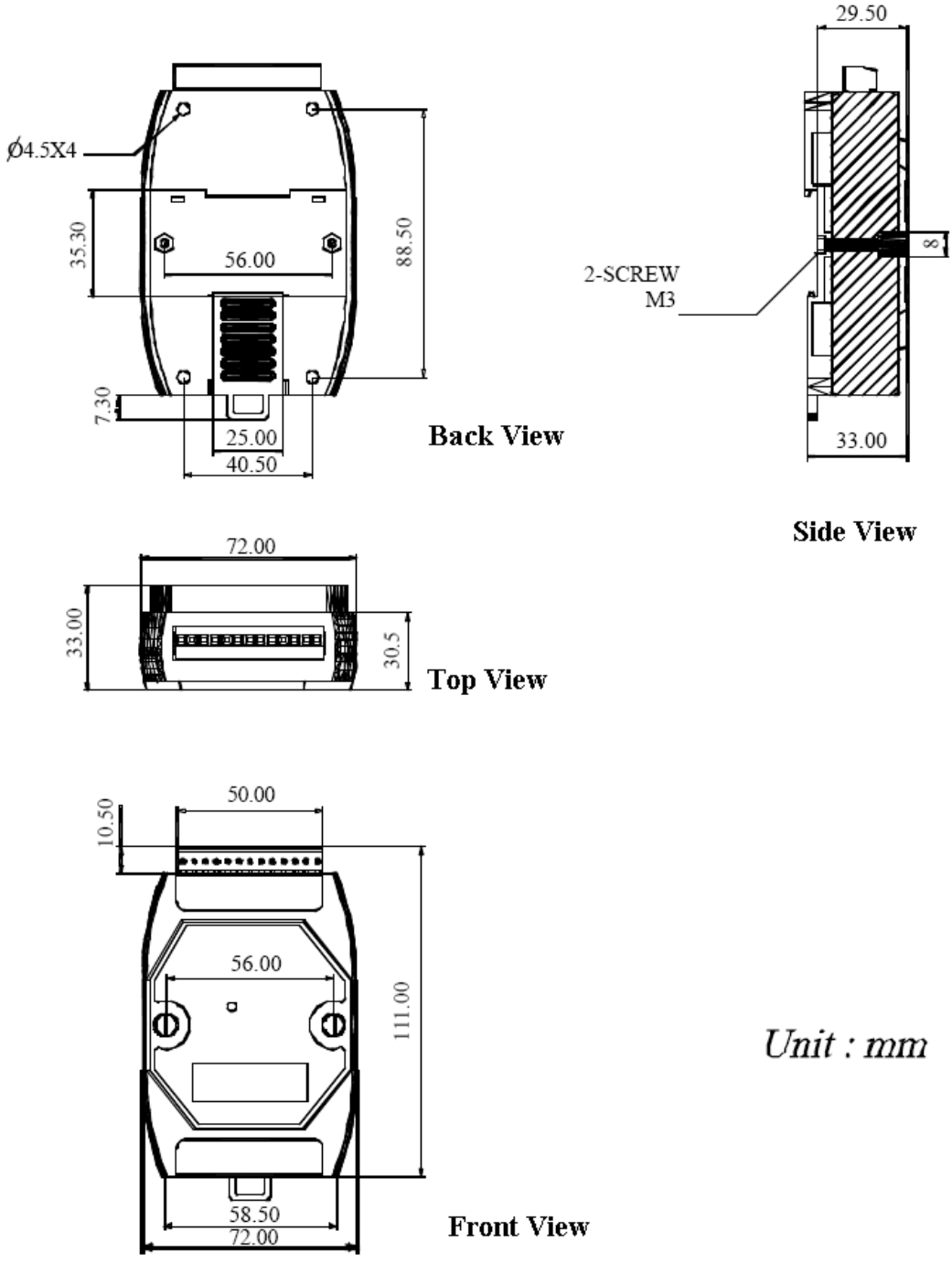


1.4.3 Block Diagram for the I-7015, I-7015P, M-7015 and M-7015P

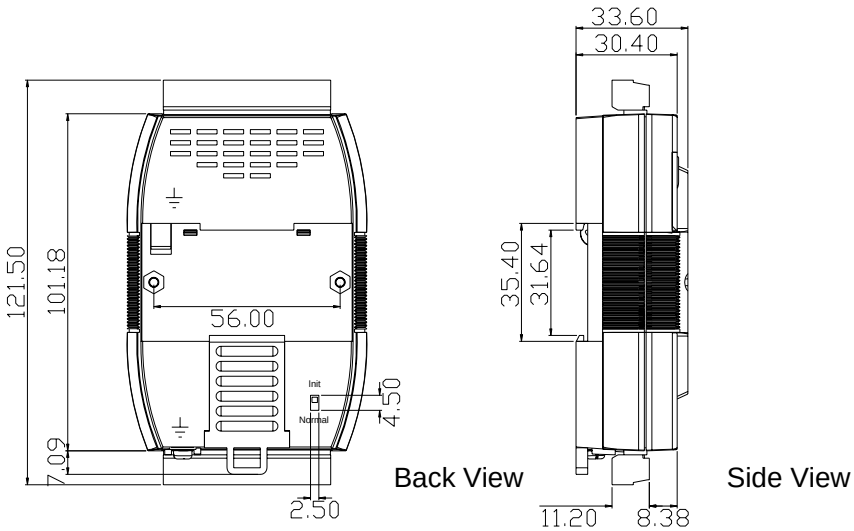


1.5 Dimensions

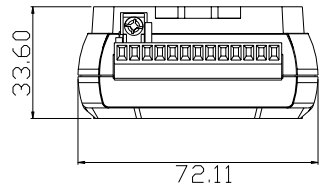
1.5.1 I-7013, I-7013D, I-7033, I-7033D, M-7033 and M-7033D Dimensions



1.5.2 I-7015, I-7015P, M-7015 and M-7015P Dimensions

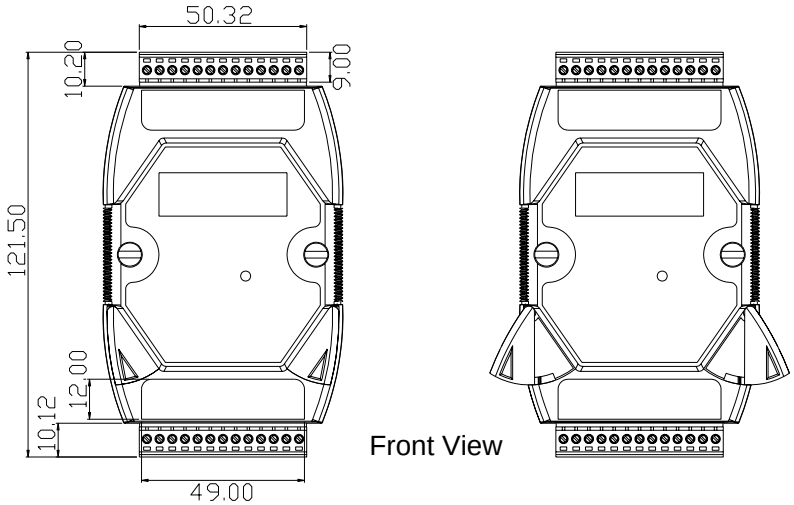


Back View Side View



Top View

Unit : mm

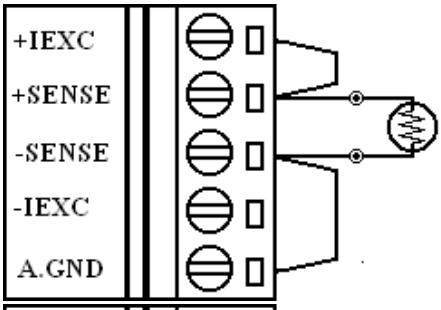


Front View

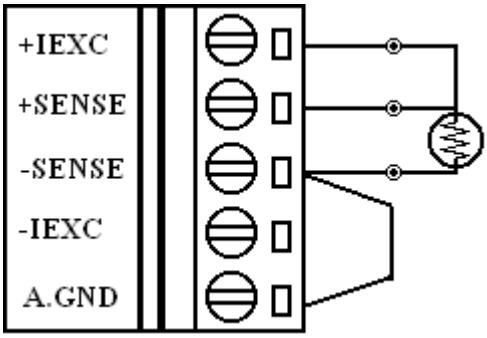
1.6 Wiring

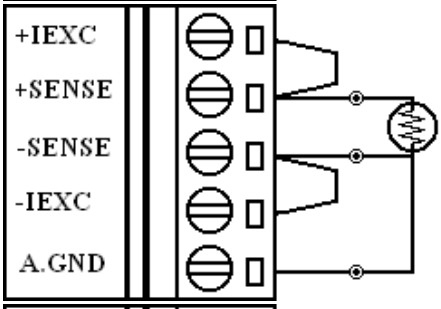
1.6.1 Wiring diagram for the I-7013, I-7013D, I-7033, I-7033D, M-7033 and M-7033D

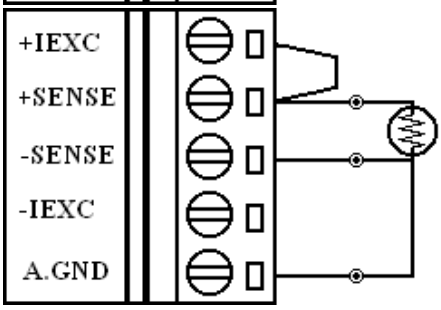
2-wire RTD connection



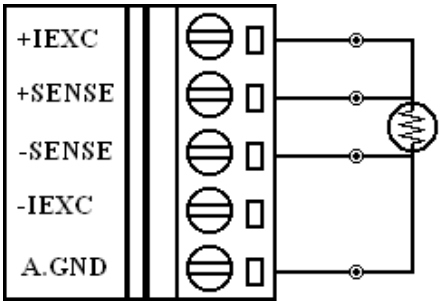
3-wire RTD connection





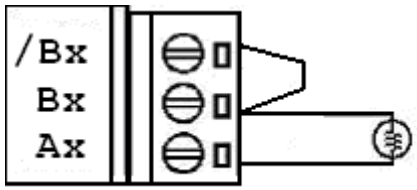


4-wire RTD connecion

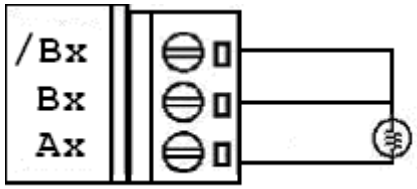


1.6.2 Wiring diagram for the I-7015, I-7015P, M-7015 and M-7015P

2-wire RTD connection



3-wire RTD connection



1.6.3 Wiring Recommendations

- Use 26-12 AWG wire for signal connections.
- Strip the wire to a length of 7±0.5mm.
- Use a crimp terminal for wiring.
- Avoid high-voltage cables and power equipment as much as possible.
- For the I-7015 and M-7015, it is recommended to use shielded wire and connect the shielding to the Ax terminal of the channel.
- For the I-7015P and M-7015P, it is recommended to use shielded wire and connect the shielding to the /Bx terminal of the channel.
- For the I-7033/33D and M-7033/33D, the wires of a channel should be shielded and the shielding should be connected to the A.GND terminal of the channel.
- For RS-485 communication, use insulated and twisted pair 24 AWG wire, e.g. Belden 9841.

1.7 Quick Start

To install the module, follow the steps below:

1. Connect the RTD sensor. See Section 1.2 for the terminal assignment and Section 1.6 for the wiring diagram.
2. Connect the module to the RS-485 network using the DATA+ and DATA- terminals. See Section 1.2 for the terminal assignment. If the host is only equipped with an RS-232 interface, then an RS-232 to RS-485 converter will be required. Refer to the "**I-7000 Bus Converter User Manual**" for more information.
3. Connect the module to the power supply using the +Vs and GND terminals. See Section 1.2 for the terminal assignment. Note that the voltage supplied to the module should be in the range of +10 to +30 VDC.
4. For I-7000 modules, configure the module by sending the %AANNTTCCFF command. See Section 2.1 for details. To configure the I-7015/15P, the $AA7CiRrr command must also be sent. See Section 2.14 for details. For M-7000 modules using the Modbus RTU protocol, configure the module using the following functions.
   - Sub-function 04h of Function 46h, see Section 3.3.2
   - Sub-function 06h of Function 46h, see Section 3.3.4
   - Sub-function 08h of Function 46h, see Section 3.3.6

   The default settings for the module can be found in Section 1.8.
5. For I-7000 modules, in order to read data from the input channels, send either the #AA or #AAN commands to the module. See Sections 2.3 and 2.4 for details. For M-7000 modules using the Modbus RTU protocol, use Function 04h to read the data from the input channels. See Section 3.2 for details.

6. If the host is a PC with a Windows operating system installed, the DCON Utility can be used to allow easy configuration and reading of data. The DCON Utility can be downloaded from the ICP DAS website (http://www.icpdas.com). The documentation for the DCON Utility can be found in the ”**Getting Started For I-7000 Series Modules**” manual.

Please refer to the “**I-7000 Bus Converter User Manual**” and ”**Getting Started For I-7000 Series Modules**” manuals for more details. The “**Getting Started For I-7000 Series Modules**” manual can be downloaded from the ICP DAS website (http://www.icpdas.com).

1.8 Default Settings

Default settings for the I-7013/13D, I-7015/15P and I-7033/33D modules are as follows:

- Module Address: 01
- RTD Type: Type 20, Pt100, -100°C to 100°C
- Baud Rate: 9600 bps
- Checksum disabled
- Engineering unit format
- Filter set at 60Hz rejection

Default settings for the M-7033/33D and M-7015/15P modules are as follows:

- Protocol: Modbus RTU
- Module Address: 01
- RTD Type: Type 20, Pt100, -100°C to 100°C
- Baud Rate: 9600 bps
- Filter set at 60Hz rejection

1.9 Calibration

Warning: *It is not recommended that calibration be performed until the process is fully understood.*

The calibration procedure is as follows:

1. Warm up the module for at least 30 minutes.
2. Set the type code to the type you wish to calibrate. Refer to Sections 2.1 and 2.14 for details.
3. Enable calibration. Refer to Section. 2.29 for details.
4. Connect the zero calibration resistor.
5. Send the zero calibration command. Refer to Sections 2.6 and 2.7 for details.
6. Connect the span calibration resistor.
7. Send the span calibration command. Refer to Sections 2.5 and 2.8 for details.
8. Repeat steps 3 to 7 three times.

Notes:

1. Use the 2-wire RTD connection to connect the calibration resistor.
2. For the I-7033/33D and M-7033/33D, connect the calibration resistor to channel 0.
3. For the I-7015, I-7015P, M-7015 and M-7015P, each channel should be calibrated separately and only the channel being calibrated should be enabled during calibration.
4. Step 3 is not needed for the I-7013 and I-7013D version A1.x and A2.x. Use the $AAF command to access the firmware version. See Section 2.20 for details.
5. Calibration resistors are shown on the next page.
6. The M-7000 series modules must be switched to the DCON protocol mode before calibrating. Refer to Sections 1.11.1 and 3.3.4 for details of the switching protocol.

Calibration resistor types used by the I-7013/13D with firmware version A1.x and A2.x:

Type	Zero Calibration Resistor	Span Calibration Resistor
20	55 Ohms	375 Ohms

Note: Types 21 to 29 use the same calibration parameters as type 20.

Calibration resistor types used by the I-7013/13D with firmware version B1.3 and later, I-7033/33D and M-7033/33D:

Type	Zero Calibration Resistor	Span Calibration Resistor
82	0 Ohms	200 Ohms
20	0 Ohms	375 Ohms
2A	0 Ohms	3200 Ohms

Note:

1. Types 21 to 29, 2E, 2F, 80 and 81 use the same calibration parameters as type 20.
2. Type 82 is only available to firmware version B1.5 and later.

Calibration resistor types used by the I-7015/15P and M-7015/15P:

For firmware version A2.9 and before:

Type	Zero Calibration Resistor	Span Calibration Resistor
2B	0 Ohms	160 Ohms
20	0 Ohms	320 Ohms
2A	0 Ohms	3000 Ohms

For firmware version B1.9 and later:

Type	Zero Calibration Resistor	Span Calibration Resistor
2B	0 Ohms	200 Ohms
20	0 Ohms	375Ohms
2A	0 Ohms	3200 Ohms

Note:

1. Types 21 to 29, 2E, 2F, 80 81 and 83 use the same calibration parameters as type 20.
2. Type 2C and 82 uses the same calibration parameters as type 2B.
3. Type 2D uses the same calibration parameters as type 2A.

1.10 Configuration Tables

Baud Rate Setting (CC)

Code	03	04	05	06	07	08	09	0A
Baud rate	1200	2400	4800	9600	19200	38400	57600	115200

Note:
For I-7015/15P and M-7015/15P firmware version B2.2 and later, bits 7 and 6 of the CC byte are used to set parity and stop bits as follows. The number of data bits is fixed to be eight.

Bits 7:6	**Description**
00	No parity and one stop bit
01	No parity and two stop bits
10	Even parity and one stop bit
11	Odd parity and one stop bit

For other firmware version of I-7015/15P and M-7015/15P and other modules, the data bits are fixed at one start bit, eight data bits, no parity and one stop bit.

RTD Type Setting (TT)

Type Code	Temperature Sensor Type	Temperature Range °C
20	Platinum 100, α = 0.00385	-100 ~ 100
21	Platinum 100, α = 0.00385	0 ~ 100
22	Platinum 100, α = 0.00385	0 ~ 200
23	Platinum 100, α = 0.00385	0 ~ 600
24	Platinum 100, α = 0.003916	-100 ~ 100
25	Platinum 100, α = 0.003916	0 ~ 100
26	Platinum 100, α = 0.003916	0 ~ 200
27	Platinum 100, α = 0.003916	0 ~ 600
28	Nickel 120	-80 ~ 100
29	Nickel 120	0 ~ 100
2A	Platinum 1000, α = 0.00385	-200 ~ 600
2B	Cu 100 @ 0°C, α = 0.00421	-20 ~ 150
2C	Cu 100 @ 25°C, α = 0.00427	0 ~ 200
2D	Cu 1000 @ 0°C, α = 0.00421	-20 ~ 150
2E	Platinum 100, α = 0.00385	-200 ~ 200
2F	Platinum 100, α = 0.003916	-200 ~ 200
80	Platinum 100, α = 0.00385	-200 ~ 600
81	Platinum 100, α = 0.003916	-200 ~ 600
82	Cu 50 @ 0°C	-50 ~ 150
83	Nickel 100	-60 ~ 180

Note:

1. Type 2A is only applicable to the I-7013/13D firmware version B1.3 and later, I-7015/15P, I-7033/33D, M-7015/15P and M-7033/33D.
2. Types 2B, 2C and 2D are only applicable to the I-7015/15P and M-7015/15P.
3. Types 2E, 2F, 80 and 81 are only applicable to the I-7013/13D firmware version B1.3 and later, I-7015 firmware version A1.10 and later, I-7033/33D firmware version B1.3 and later, I-7015P, M-7015/15P and M-7033/33D.
4. Types 82 is only applicable to the I-7013/13D firmware version B1.5 and later, I-7015 and M-7015 firmware version A2.3 and later, I-7033/33D firmware version B1.5 and later, I-7015P, M-7015P and M-7033/33D.
5. Type 83 is only applicable to the I-7015 and M-7015 firmware version A2.9 and later, I-7015P and M-7015P.

Data Format Setting (FF)

7	6	5	4	3	2	1	0
FS	CS	reserved				DF	

Key	Description
DF	Data format 00: Engineering unit 01: % of FSR (full scale range) 10: 2's complement hexadecimal 11: Ohms
CS	Checksum setting 0: Disabled 1: Enabled
FS	Filter setting 0: 60Hz rejection 1: 50Hz rejection This setting is reserved for the I-7015 and M-7015 firmware version A2.9 and before and should be zero.

Note: The reserved bits should be zero.

RTD Type and Data Format Table

Type Code	RTD Type	Data Format	+F.S.	-F.S.
20	Platinum 100 α = 0.00385 -100 ~ 100°C	Engineering unit	+100.00	-100.00
		% of FSR	+100.00	-100.00
		2's comp HEX	7FFF	8000
		Ohms	+138.50	+060.60
21	Platinum 100 α = 0.00385 0 ~ 100°C	Engineering unit	+100.00	+000.00
		% of FSR	+100.00	+100.00
		2's comp HEX	7FFF	0000
		Ohms	+138.50	+100.00
22	Platinum 100 α = 0.00385 0 ~ 200°C	Engineering unit	+200.00	+000.00
		% of FSR	+100.00	+000.00
		2's comp HEX	7FFF	0000
		Ohms	+175.84	+100.00
23	Platinum 100 α = 0.00385 0 ~ 600°C	Engineering unit	+600.00	+000.00
		% of FSR	+100.00	+000.00
		2's comp HEX	7FFF	0000
		Ohms	+313.59	+100.00
24	Platinum 100 α = 0.003916 -100 ~ 100°C	Engineering unit	+100.00	-100.00
		% of FSR	+100.00	-100.00
		2's comp HEX	7FFF	8000
		Ohms	+139.16	+060.60
25	Platinum 100 α = 0.003916 0 ~ 100°C	Engineering unit	+100.00	+000.00
		% of FSR	+100.00	+000.00
		2's comp HEX	7FFF	0000
		Ohms	+139.16	+100.00
26	Platinum 100 α = 0.003916 0 ~ 200°C	Engineering unit	+200.00	+000.00
		% of FSR	+100.00	+000.00
		2's comp HEX	7FFF	0000
		Ohms	+177.14	+100.00
27	Platinum 100 α = 0.003916 0 ~ 600°C	Engineering unit	+600.00	+000.00
		% of FSR	+100.00	+000.00
		2's comp HEX	7FFF	0000
		Ohms	+317.28	+100.00

Type Code	RTD Type	Data Format	+F.S.	-F.S.
28	Nickel 120 -80 ~ 100°C	Engineering unit	+100.00	-080.00
		% of FSR	+100.00	-080.00
		2's comp HEX	7FFF	999A
		Ohms	+200.64	+066.60
29	Nickel 120 0 ~ 100°C	Engineering unit	+100.00	+000.00
		% of FSR	+100.00	+000.00
		2's comp HEX	7FFF	0000
		Ohms	+200.64	+120.60
2A[*1]	Platinum 1000 α = 0.00385 -200 ~ 600°C	Engineering unit	+600.00	-200.00
		% of FSR	+100.00	-033.33
		2's comp HEX	7FFF	D556
		Ohms	+3137.1	+0185.2
2B[*2]	Cu 100 α = 0.00421 -20 ~ 150°C	Engineering unit	+150.00	-020.00
		% of FSR	+100.00	-013.33
		2's comp HEX	7FFF	EEEF
		Ohms	+163.17	+091.56
2C[*2]	Cu 100 α = 0.00427 0 ~ 200°C	Engineering unit	+200.00	+000.00
		% of FSR	+100.00	+000.00
		2's comp HEX	7FFF	0000
		Ohms	+167.75	+090.34
2D[*2]	Cu 1000 α = 0.00421 -20 ~ 150°C	Engineering unit	+150.00	-020.00
		% of FSR	+100.00	-013.33
		2's comp HEX	7FFF	EEEF
		Ohms	+1631.7	+0915.6
2E[*3]	Platinum 100 α = 0.00385 -200 ~ 200°C	Engineering unit	+200.00	-200.00
		% of FSR	+100.00	-100.00
		2's comp HEX	7FFF	8000
		Ohms	+175.84	+018.49
2F[*3]	Platinum 100 α = 0.003916 -200 ~ 200°C	Engineering unit	+200.00	-200.00
		% of FSR	+100.00	-100.00
		2's comp HEX	7FFF	8000
		Ohms	+177.14	+017.14

Type Code	RTD Type	Data Format	+F.S.	-F.S.
80[*3]	Platinum 100 α = 0.00385 -200 ~ 600°C	Engineering unit	+600.00	-200.00
		% of FSR	+100.00	-033.33
		2's comp HEX	7FFF	D556
		Ohms	+313.59	+018.49
81[*3]	Platinum 100 α = 0.003916 -200 ~ 600°C	Engineering unit	+600.00	-200.00
		% of FSR	+100.00	-033.33
		2's comp HEX	7FFF	D556
		Ohms	+317.28	+017.14
82[*4]	Cu 50 -50 ~ 150°C	Engineering unit	+150.00	-050.00
		% of FSR	+100.00	-033.33
		2's comp HEX	7FFF	D556
		Ohms	+082.13	+039.24
83[*5]	Nickel 100 -60 ~ 180°C	Engineering unit	+180.00	-060.00
		% of FSR	+100.00	-033.33
		2's comp HEX	7FFF	D556
		Ohms	+223.10	+069.50

*1: only available with the I-7013/13D firmware version B1.3 and later, I-7015/15P, I-7033/33D, M-7015/15P and M-7033/33D.
*2: only available with the I-7015/15P and M-7015/15P.
*3: only available with the I-7013/13D firmware version B1.3 and later, I-7015 firmware version A1.10 and later, I-7033/33D firmware version B1.3 and later, I-7015P, M-7015/15P and M-7033/33D.
*4: only available with the I-7013/13D firmware version B1.5 and later, I-7015/M-7015 firmware version A2.3 and later, I-7033/33D firmware version B1.5 and later, I-7015P, M-7015P and M-7033/33D.
*5: only available with the I-7015/M-7015 firmware version A2.9 and later, I-7015P and M-7015P.

RTD Over Range/Under Range Reading for the I-7013/13D, I-7033/33D and M-7033/33D

	Over Range	Under Range
Engineering Unit	+9999	-0000
% of FSR	+9999	-0000
2's Complement HEX	7FFF	8000

Note: For firmware version B1.3 and later, the over range/under range reading can be the same as that of the I-7015 as follows by sending the ~AADVV command. Refer to Section 2.28 for details.

RTD Over Range/Under Range Reading for the I-7015/15P and M-7015/15P

	Over Range	Under Range
Engineering Unit	+9999.9	-9999.9
% of FSR	+999.99	-999.99
2's Complement HEX	7FFF	8000

RTD Over Range/Under Range Reading for the M-7015/15P and M-7033/33D with Modbus RTU protocol

Over Range	Under Range
7FFFh	8000h

1.11 M-7000 Notes

The main difference between the I-7000 and M-7000 series is that the M-7000 series has additional support for the Modbus RTU communication protocol, which is the default protocol of the M-7000 series. The communication Baud Rates for the Modbus RTU protocol can be in the range of 1200 bps to 115200 bps, and the parity, data and stop bits are fixed as no parity, 8 data bits and 1 stop bit.

Modbus functions supported by the module are described in Chapter 3.

1.11.1 Protocol Switching

To switch to the DCON protocol:

1. Uses sub-function 06h of the function 46h and set byte 8 to a value of 1. See Section 3.3.4 for details.
2. After a power-on reset, the communication protocol will be changed to DCON.

To switch to the Modbus RTU protocol:

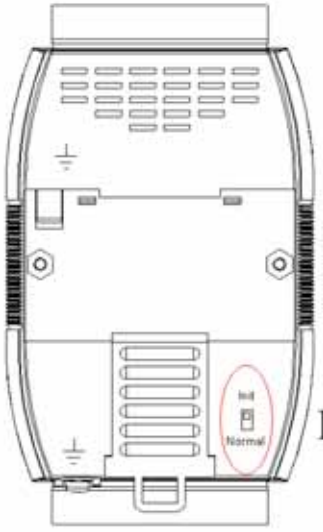
1. Sends the $AAPN command and set N to a value of 1. Note that for the M-7033/33D, the INIT* terminal should be connected to the GND terminal, and for the M-7015/15P, the slide switch on the rear side of the module should be set to the INIT position, see the figure on the next page. See Section 2.24 for details.
2. After a power-on reset, the communication protocol will be changed to the Modbus RTU protocol.

1.11.2 INIT Mode

When the module is powered on, with the rear slide switch set to the INIT position as shown in the figure below for the M-7015/15P, or with the INIT* pin connected to the GND pin for the M-7033/33D, the module is in INIT mode, (see Section A.1 for details), and the communication settings are as follows:

1. Address: 00
2. Baud Rate: 9600 bps
3. No checksum
4. Protocol: DCON

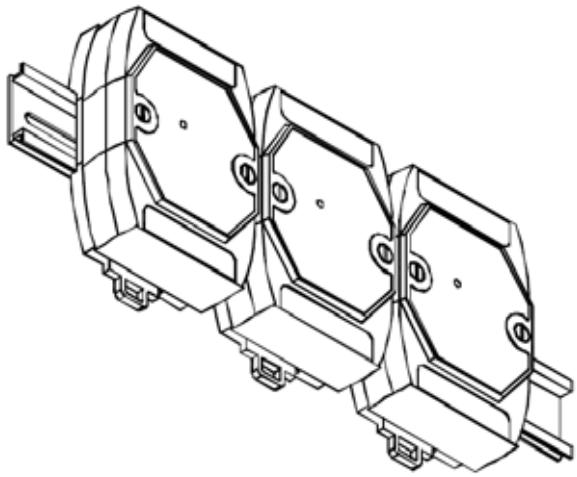
If communication with the module is not possible, set the module to the INIT mode and use the above settings to communicate with the module. To read the current settings, send the commands $AA2, (see Section 2.9), and $AAP, (see Section 2.23). To set new settings, send the commands %AANNTTCCFF, (see Section 2.1) and $AAPN, (see Section 2.24). The new communication settings will be effective after the next power-on reset.



INIT Switch

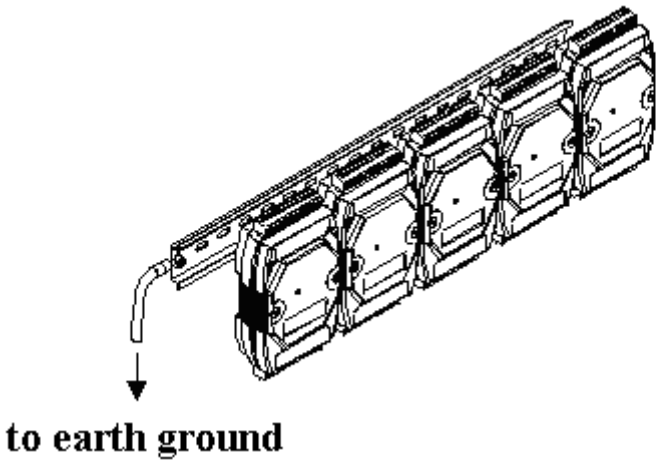
1.12 Mounting

1.12.1 Din-Rail Mounting

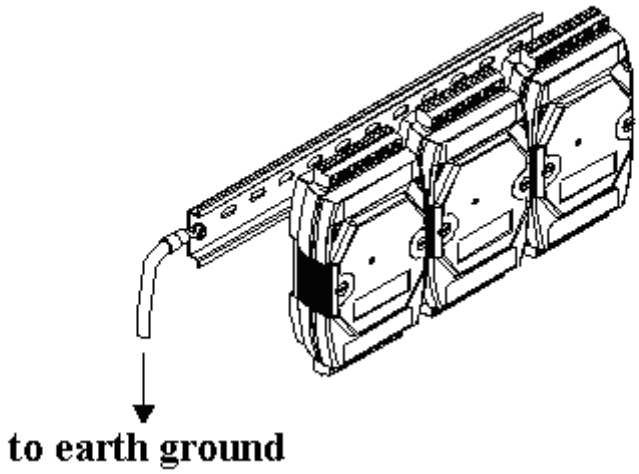


There are three new DIN rail models available. Each is made of stainless steel, which is stronger than those made of aluminum. There is a screw at one end and a ring terminal is included so that it can be easily connected to the earth ground. The three new DIN rail models are as follows.

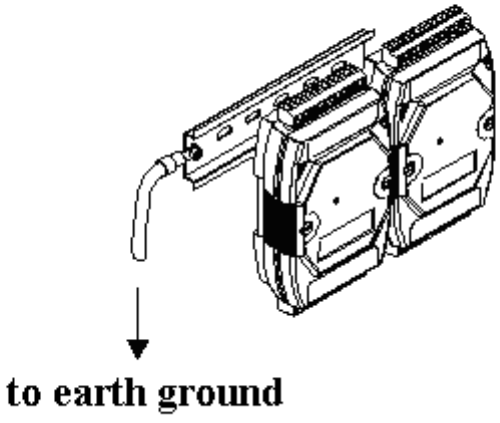
Part number	Max. number of modules	Dimensions
DRS-360	5	360mm x 35mm



Part number	Max. number of modules	Dimensions
DRS-240	3	240mm x 35mm



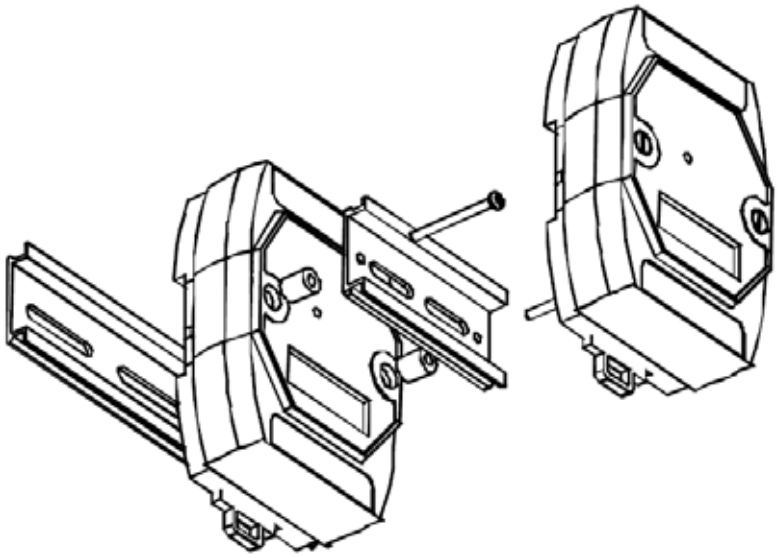
Part number	Max. number of modules	Dimensions
DRS-125	2	125mm x 35mm



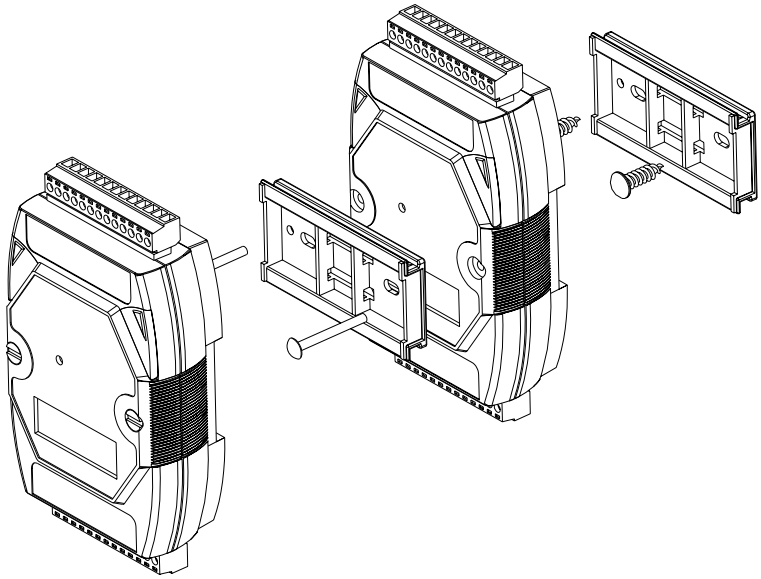
Note: It is recommended that a 16 – 14 AWG wire is used to connect the DIN rail to the earth ground.

1.12.2 Piggyback Mounting

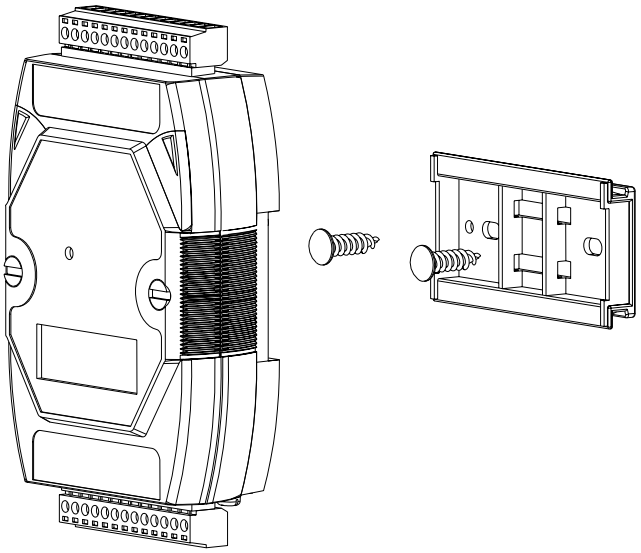
For I-7013/13D, I-7033/33D and M-7033/33D modules



For I-7015/15P and M-7015/15P modules



1.12.3 Wall Mounting



1.13 Technical Support

Should you encounter any problems while using the I-7000 and M-7000 module, and are unable to find the help you need in this manual or on our website, please contact ICP DAS Product Support.

Email: support@icpdas.com
Website: http://www.icpdas.com/service/support.htm

When requesting technical support, be prepared to provide the following information about your system:

1. Module name and serial number: The serial number can be found printed on the barcode label attached to the cover of the module.
2. Firmware version: See Sections 2.20 and 3.3.7 for information regarding the command used to identify the firmware version.
3. Host configuration (type and operating system)
4. If the problem is reproducible, please give full details describing the procedure used to reproduce the problem.
5. Any specific error messages displayed. If a dialog box with an error message is displayed, please include the full text of the dialog box, including the text in the title bar.
6. If the problem involves other programs or hardware devices, please describe the details of the problem in full.
7. Any comments and suggestions related to the problem are welcome.

ICP DAS will reply to your request by email within three business days.

2. DCON Protocol

All communication with I-7000 modules consists of commands generated by the host and responses transmitted by the I-7000 modules. Each module has a unique ID number that is used for addressing purposes and is stored in non-volatile memory. The ID is 01 by default and can be changed using a user command. All commands to the modules contain the ID address, meaning that only the addressed module will respond. The only exception to this is commands #** (Section 2.2) and ~** (Section 2.33), which are sent to all modules, but in both of these cases, the modules do not reply to the command.

Command Format:

Leading Character	Module Address	Command	[CHKSUM]	CR

Response Format:

Leading Character	Module Address	Data	[CHKSUM]	CR

CHKSUM A 2-character checksum which is present when the checksum setting is enabled. See Sections 1.10 (Data Format Setting) and 2.1 for details.

CR End of command character, carriage return (0x0D)

Checksum Calculation:

1. Calculate the ASCII code sum of all the characters in the command/response string except for the carriage return character (CR).
2. The checksum is equal to the sum masked by 0FFh.

Example:

Command string: $012(CR)

1. Sum of the string = “$”+”0”+”1”+”2” = 24h+30h+31h+32h = B7h
2. Therefore the checksum is B7h, and so CHKSUM = “B7”
3. The command string with the checksum = $012B7(CR)

Response string: !01200600(CR)

1. Sum of the string = “!”+”0”+”1”+”2”+”0”+”0”+”6”+”0”+”0” = 21h+30h+31h+32h+30h+30h+36h+30h+30h = 1AAh
2. Therefore the checksum is AAh, and so CHKSUM = “AA”
3. The response string with the checksum = !01200600AA(CR)

Note:

All characters should be in upper case.

General Command Sets			
Command	**Response**	**Description**	**Section**
%AANNTTCCFF	!AA	Sets the module configuration	2.1
#**	No Response	Synchronized sampling	2.2
#AA	>(Data)	Reads the analog inputs of all channels	2.3
#AAN	>(Data)	Reads the analog input of a channel	2.4
$AA0	!AA	Performs a span calibration	2.5
$AA1	!AA	Performs a zero calibration	2.6
$AA0Ci	!AA	Performs a single channel zero calibration	2.7
$AA1Ci	!AA	Performs a single channel span calibration	2.8
$AA2	!AANNTTCCFF	Reads the module configuration	2.9
$AA4	>AAS(Data)	Reads the synchronized data	2.10
$AA5	!AAS	Reads the module reset status	2.11
$AA5VV	!AA	Enables/Disables a channel	2.12
$AA6	!AAVV	Reads the channel enabled/disabled status	2.13
$AA7CiRrr	!AA	Sets a single channel range configuration	2.14
$AA8Ci	!AACiRrr	Reads a single channel range configuration	2.15
$AA8	!AAV	Reads the LED configuration	2.16
$AA8V	!AA	Sets the LED configuration	2.17
$AA9(Data)	!AA	Sets the LED display data	2.18
$AAB	!AANN	Reads the channel diagnostic status	2.19
$AAF	!AA(Data)	Reads the firmware version	2.20
$AAI	!AAS	Reads the INIT terminal status	2.21
$AAM	!AA(Data)	Reads the module name	2.22
$AAP	!AASC	Reads the communication protocol	2.23
$AAPN	!AA	Sets the communication protocol	2.24
$AAS0	!AA	Internal Calibration	2.25
$AAS1	!AA	Reloads the default calibration parameters	2.26
~AAD	!AAVV	Reads the miscellaneous settings	2.27
~AADVV	!AA	Sets the miscellaneous settings	2.28
~AAEV	!AA	Enables/Disables calibration	2.29
~AAI	!AA	Soft INIT	2.30
~AAO(Name)	!AA	Sets the module name	2.31
~AATnn	!AA	Sets the soft INIT timeout	2.32

Host Watchdog Command Sets			
Command	**Response**	**Description**	**Section**
~**	No Response	Host is OK	2.33
~AA0	!AASS	Reads the host watchdog status	2.34
~AA1	!AA	Resets the host watchdog status	2.35
~AA2	!AAETT	Reads the host watchdog timeout settings	2.36
~AA3ETT	!AA	Sets the host watchdog timeout settings	2.37

2.1 %AANNTTCCFF

Description:

Sets the configuration of an analog input module.

Syntax:

%AANNTTCCFF[CHKSUM](CR)

% Delimiter character

AA Address of the module to be configured in hexadecimal format (00 to FF)

NN New address of the module in hexadecimal format (00 to FF)

TT New type code, see Section 1.10 for details. Not used by the I-7015/15P and M-7015/15P. For the I-7015/15P and M-7015/15P, use the $AA7CiRrr command to set the type of each channel, see Section 2.14 for details.

CC New Baud Rate code, see Section 1.10 for details. For the I-7013/13D, I-7033/33D and M-7033/33D, the INIT* terminal must be connected to GND terminal in order to change Baud Rates. In the I-7015/15P and M-7015/15P, this is achieved by moving the rear slide switch to the INIT position. See Section A.1 for details.

FF Used to set the data format, checksum, and filter settings (Section 1.10). For the I-7013/13D, I-7033/33D and M-7033/33D, the INIT* terminal must be connected to GND terminal in order to change the checksum setting. In the I-7015/15P and M-7015/15P, this is achieved by moving the rear slide switch to the INIT position. See Section A.1 for details.

Note: The filter setting is not available in either the I-7015 or M-7015 firmware version B2.9 and before.

Response:

Valid Command: **!AA[CHKSUM](CR)**
Invalid Command: **?AA[CHKSUM](CR)**

! Delimiter for a valid command

? Delimiter for an invalid command. If the **Baud Rate** or **checksum** settings are changed without connecting the INIT* terminal to ground or switching the rear slide switch to the INIT position, the module will return an invalid command.

AA Address of the module in hexadecimal format (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: %0102200600 Response: !02

Changes the address of module 01 to 02. The module returns a valid response.

Command: %0202200603 Response: !02

Sets the data format of module 02 to be 3 (Ohms). The module returns a valid response.

Command: %0101200A00 Response: ?01

Changes the Baud Rate of module 01 to 115200bps. The module returns an invalid command, because it is not in INIT* mode.

Command: %0101200A00 Response: !01

Changes the Baud Rate of module 01 to 115200bps and the module is in INIT* mode. The module returns a valid response.

Related Commands:

Section 2.9 $AA2, Section 2.30 ~AAI, Section 2.32 ~AATnn

Related Topics:

Section 1.10 Configuration Tables, Section A.1 INIT* pin Operation

Notes:

1. Changes to the address, type code, data format and filter settings take effect immediately after a valid command is received. Changes to the Baud Rate and checksum settings take effect on the next power-on reset.
2. For the I-7015/15P and M-7015/15P, changing the Baud Rate and checksum settings can be achieved by software only and is performed by using the following commands:
   I. Send a ~AATnn command. See Section 2.32 for details.
   II. Send a ~AAI command. See Section 2.30 for details.
   III. Send a %AANNTTCCFF command.
   If the command is valid, the Baud Rate and checksum settings will be changed after the module responds with !AA.

2.2 #**

Description:

When the command is received, it will allow all analog input modules to read data from all input channels and will store the data for later retrieval.

Syntax:

#[CHKSUM](CR)**

Delimiter character

** Synchronized sampling command

Response:

There is no response with this command. To access the data, another command, $AA4, must be sent, see Section 2.10 for details.

Examples:

Command: #** No response

Sends the synchronized sampling command.

Command: $014 Response: >011+025.123

Sends a command to read the synchronized data. The status byte of the response is 1, which means that it is the first time the synchronized data has been read after the previous #** command.

Command: $014 Response: >010+025.123

Sends a command to read the synchronized data. The status byte of the response is 0, which means that it is **NOT** the first time the synchronized data has been read after the previous #** command.

Related Commands:

Section 2.10 $AA4

Notes:

This command is only applicable to the I-7015/15P, M-7015/15P, and I-7013/13D.

2.3 #AA

Description:

Reads the data from all analog input channels.

Syntax:

#AA[CHKSUM](CR)

#	Delimiter character
AA	Address of the module to be read (00 to FF)

Response:

Valid Command: **>(Data)[CHKSUM](CR)**
Invalid Command: **?AA[CHKSUM](CR)**

>	Delimiter character for a valid command
?	Delimiter character for an invalid command
(Data)	Data from all analog input channels, see Section 1.10 for the data format. For both the I-7015/15P and M-7015/15P, data from disabled channels is filled with space characters.
AA	Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: #01 Response: >+026.35

Reads module 01 and receives the data in engineering format.

Command: #02 Response: >4C53

Reads module 02 and receives the data in hexadecimal format.

Command: #03 Response: >-0000

Reads module 03 and the data is under range.

Command: #04 Response: >+025.12+054.12+150.12

Reads module 04, an I-7033, and receives the data from 3 channels.

Related Commands:

Section 2.1 %AANNTTCCFF, Section 2.9 $AA2

Related Topics:

Section 1.10 Configuration Tables

2.4 #AAN

Description:

Reads the analog input of channel N.

Syntax:

#AAN[CHKSUM](CR)

#	Delimiter character
AA	Address of the module to be read (00 to FF)
N	The channel to be read, zero based.

Response:

Valid Command: **>(Data)[CHKSUM](CR)**
Invalid Command: **?AA[CHKSUM](CR)**

>	Delimiter character for a valid command
?	Delimiter character for an invalid command. An invalid command is returned if the specified channel is incorrect.
(Data)	Analog input data of the specified channel, see Section 1.10 for the data format. For the I-7015/15P and M-7015/15P, if the specified channel is disabled, then the data field will be filled with space characters.
AA	Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: #032 Response: >+025.13

Reads data from channel 2 of module 03.

Command: #029 Response: ?02

Reads data from channel 9 of module 02. An error is returned because channel 9 is invalid.

Related Commands:

Section 2.1 %AANNTTCCFF, Section 2.9 $AA2

Related Topics:

Section 1.10 Configuration Tables

Notes:

This command is only applicable to the I-7015/15P, M-7015/15P, I-7033/33D and M-7033/33D.

2.5 $AA0

Description:

Performs a span calibration.

Syntax:

$AA0[CHKSUM](CR)

$	Delimiter character
AA	Address of the module to be calibrated (00 to FF)
0	Command for the span calibration

Response:

Valid Command: **!AA[CHKSUM](CR)**

Invalid Command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: $010 Response: !01

Performs a span calibration on module 01 and returns a valid response.

Command: $020 Response: ?02

Performs a span calibration on module 02. An invalid command is returned because the “enable calibration” command was not sent in advance.

Related Commands:

Section 2.6 $AA1, Section 2.29 ~AAEV

Related Topics:

Section 1.9 Calibration

Notes:

1. This command is only applicable to the I-7013/13D, I-7033/33D and M-7033/33D.
2. The “enable calibration” command, ~AAEV and the “zero calibration” command, $AA1, must be sent before this command is used, see Sections 1.9 and 2.6 for details.

2.6 $AA1

Description:

Performs a zero calibration.

Syntax:

$AA1[CHKSUM](CR)

$	Delimiter character
AA	Address of the module to be calibrated (00 to FF)
1	Command for the zero calibration

Response:

Valid Command: **!AA[CHKSUM](CR)**
Invalid Command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: $011 Response: !01
Performs a zero calibration on module 01 and returns a valid response.

Command: $021 Response: ?02
Performs a zero calibration on module 02. An invalid command is returned because the “enable calibration” command was not sent in advance.

Related Commands:

Section 2.5 $AA0, Section 2.29 ~AAEV

Related Topics:

Section 1.9 Calibration

Notes:

1. This command is only applicable to the I-7013/13D, I-7033/33D and M-7033/33D.
2. The “enable calibration” command, ~AAEV, must be sent before this command is used, see Section 1.9 for details.
3. This command must be sent before the “span calibration” command, $AA0, is used.

2.7 $AA0Ci

Description:

Performs a zero calibration on the specified channel.

Syntax:

$AA0Ci[CHKSUM](CR)

$	Delimiter character
AA	Address of the module to be calibrated (00 to FF)
0	Command for the zero calibration
Ci	Specifies the channel to be calibrated

Response:

Valid Command: **!AA[CHKSUM](CR)**

Invalid Command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command. An invalid command is returned if the specified channel is incorrect.
AA	Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: $010C0 Response: !01

Performs a zero calibration on channel 0 of module 01 and returns a valid response.

Command: $020C5 Response: !02

Performs a zero calibration on channel 5 of module 02 and returns a valid response.

Command: $030C1 Response: ?03

Performs a zero calibration on channel 1 of module 03. An invalid command is returned because the "enable calibration" command was not sent in advance.

Related Commands:

Section 2.8 $AA1Ci, Section 2.29 ~AAEV

Related Topics:

Section 1.9 Calibration

Notes:

1 This command is only applicable to the I-7015/15P and M-7015/15P.
2 The "enable calibration" command, ~AAEV, must be sent before this command is used, see Section 1.9 for details.
3 This command must be sent before the "span calibration" command, $AA1Ci, is used.
4 This command takes about 8 seconds for firmware version A2.9 and before.

2.8 $AA1Ci

Description:

Performs a span calibration on the specified channel.

Syntax:

$AA1Ci[CHKSUM](CR)

$	Delimiter character
AA	Address of the module to be calibrated (00 to FF)
1	Command for the span calibration
Ci	Specifies the channel to be calibrated

Response:

Valid Command: **!AA[CHKSUM](CR)**

Invalid Command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command. An invalid command is returned if the specified channel is incorrect.
AA	Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: $011C0 Receive: !01

Performs a span calibration on channel 0 of module 01 and returns a valid response.

Command: $021C5 Receive: !02

Performs a span calibration on channel 5 of module 02 and returns a valid response.

Command: $031C1 Receive: ?03

Performs a span calibration on channel 1 of module 03. An invalid command is returned because the "enable calibration" command was not sent in advance.

Related Commands:

Section 2.7 $AA0Ci, Section 2.29 ~AAEV

Related Topics:

Section 1.9 Calibration

Notes:

1. The command is only applicable to the I-7015/15P and M-7015/15P.
2. The "enable calibration" command, ~AAEV, and the "zero calibration" command, $AA0Ci, must be sent before this command is used, see Sections 1.9 and 2.7 for details.
3. This command takes about 8 seconds for firmware version A2.9 and before.

2.9 $AA2

Description:

Reads the module configuration.

Syntax:

$AA2[CHKSUM](CR)

$	Delimiter character
AA	Address of the module to be read (00 to FF)
2	Command to read the module configuration

Response:

Valid Command: **!AATTCCFF[CHKSUM](CR)**

Invalid Command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)
TT	Type code of the module, see Section 1.10 for details.
CC	Baud Rate code of the module, see Section 1.10 for details.
FF	Data format, checksum settings and filter settings of the module, see Section 1.10 for details.

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: $012 Response: !01200600

Reads the configuration of module 01.

Command: $022 Response: !02230602

Reads the configuration of module 02.

Related Commands:

Section 2.1 %AANNTTCCFF

Related Topics:

Section 1.10 Configuration Tables

2.10 $AA4

Description:

Reads the synchronized data that was retrieved by the last #** command.

Syntax:

$AA4[CHKSUM](CR)

$	Delimiter character
AA	Address of the module to be read (00 to FF)
4	Command to read the synchronized data

Response:

Valid Command: **>AAS(Data)[CHKSUM](CR)**

Invalid Command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)
S	Status of the synchronized data 1: first read 0: not the first read
(Data)	Synchronized data. See Section 1.10 for the data format. For the I-7015/15P and M-7015/15P modules, data from disabled channels is filled with space characters.

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: $014 Response: ?01

Reads the synchronized data for module 01. An invalid command is returned because the #** command has not been issued in advance.

Command: #** No response

Sends the synchronized sampling command.

Command: $014 Response: >011+025.56

Reads the synchronized data for module 01. The module returns the synchronized data and sets the status byte to 1 to indicate that this is the first time the synchronized data has been read.

Command: $014 Response: >010+25.56

Reads the synchronized data for module 01. The module returns the synchronized data and sets the status byte to 0 to indicate that the synchronized data has been read.

Related Commands:

Section 2.2 #**

Notes:

This command is only applicable to the I-7015/15P, M-7015/15P and I-7013/13D.

2.11 $AA5

Description:

Reads the reset status of a module.

Syntax:

$AA5[CHKSUM](CR)

$	Delimiter character
AA	Address of the module to be read (00 to FF)
5	Command to read the module reset status

Response:

Valid Command: **!AAS[CHKSUM](CR)**
Invalid Command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)
S	Reset status of the module 1: This is the first time the command has been sent since the module was powered on. 0: This is not the first time the command has been sent since the module was powered on, which denotes that there has been no module reset since the last $AA5 command was sent.

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: $015 Response: !011

Reads the reset status of module 01. The response shows that it is the first time the $AA5 command has been sent since the module was powered-on.

Command: $015 Response: !010

Reads the reset status of module 01. The response shows that there has been no module reset since the last $AA5 command was sent.

2.12 $AA5VV

Description:

Specifies the channels to be enabled.

Syntax:

$AA5VV[CHKSUM](CR)

$	Delimiter character
AA	Address of the module to be set (00 to FF)
5	Command to set the channels to enabled
VV	A two-digit hexadecimal value, where bit 0 corresponds to channel 0, bit 1 corresponds to channel 1, etc. When the bit is 1, it denotes that the channel is enabled, and 0 denotes that the channel is disabled.

Response:

Valid Command: **!AA[CHKSUM](CR)**

Invalid Command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command. An invalid command is returned if an attempt is made to enable a channel that is not present.
AA	Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: $0153A Response: !01

Enables channels 1, 3, 4, and 5 and disables all other channels of module 01. The module returns a valid response.

Command: $016 Response: !013A

Reads the channel status of module 01. The module returns a response of 3A, which denotes that channels 1, 3, 4, and 5 are enabled and all other channels are disabled.

Related Commands:

Section 2.13 $AA6

Notes:

This command is only applicable to the I-7015/15P and M-7015/15P. It is recommended that only the channels to be used are enabled.

2.13 $AA6

Description:

Reads the enabled/disabled status of each channel.

Syntax:

$AA6[CHKSUM](CR)

$	Delimiter character
AA	Address of the module to be read (00 to FF)
6	Command to read the channel status

Response:

Valid Command: **!AAVV[CHKSUM](CR)**

Invalid Command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)
VV	A two-digit hexadecimal value, where bit 0 corresponds to channel 0, bit 1 corresponds to channel 1, etc. When the bit is 1, it denotes that the channel is enabled, and 0 denotes that the channel is disabled.

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: $0153A Response: !01

Enables channels 1, 3, 4, and 5 and disables all other channels of module 01. The module returns a valid response.

Command: $016 Response: !013A

Reads the channel status of module 01 and returns a response of 3A, which denotes that channels 1, 3, 4, and 5 are enabled and all other channels are disabled.

Related Commands:

Section 2.12 $AA5VV

Notes:

This command is only applicable to the I-7015/15P and M-7015/15P.

2.14 $AA7CiRrr

Description:

Sets the type code of a channel.

Syntax:

$AA7CiRrr[CHKSUM](CR)

$	Delimiter character
AA	Address of the module to be set (00 to FF)
7	Command to set the channel range code
Ci	i specifies the input channel to be set (0-5)
Rrr	rr represents the type code of the channel to be set. Refer to the Temperature Sensor Type Setting table in Section 1.10.

Response:

Valid command: **!AA [CHKSUM](CR)**

Invalid command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command or invalid type code
AA	Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: $017C0R20 Response: !01

Sets the type code for channel 0 of module 01 to be 20 (PT100, -100 ~ +100℃) and the module returns a valid response.

Command: $027C5R28 Response: !02

Sets the type code for channel 5 of module 02 to be 28 (Ni120, -80 ~ +100℃) and the module returns a valid response.

Command: $037C1R30 Response: ?03

Sets the type code for channel 1 of module 03 to be 30. The module returns an invalid response because the type code is invalid.

Related Commands:

Section 2.15 $AA8Ci

Related Topics:

Section 1.10 Configuration Tables

Notes:

This command is only applicable to the I-7015/15P and M-7015/15P.

2.15 $AA8Ci

Description:

Reads the type code information of a channel.

Syntax:

$AA8Ci[CHKSUM](CR)

$	Delimiter character
AA	Address of the module to be read (00 to FF)
8	Command to read the type code of a channel
Ci	Specifies which channel to access for the type code information (i = 0 ~ 5)

Response:

Valid command: **!AACiRrr[CHKSUM](CR)**

Invalid command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command or invalid channel
AA	Address of the responding module (00 to FF)
Ci	Specifies which input channel the type code information relates to.
Rrr	Represents the type code of the specified input channel. Refer to the Temperature Sensor Type Setting table in Section 1.10.

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: $018C0 Response: !01C0R20

Reads the input range of channel 0 of module 01 and returns 20 (PT100, -100 ~ +100℃).

Related Commands:

Section 2.14 $AA7CiRrr

Related Topics:

Section 1.10 Configuration Tables

Notes:

This command is only applicable to the I-7015/15P and M-7015/15P.

2.16 $AA8

Description:

Reads the LED configuration information of a module.

Syntax:

$AA8[CHKSUM](CR)

$	Delimiter character
AA	Address of the module to be read (00 to FF)
8	Command to read the LED configuration

Response:

Valid Command: **!AAV[CHKSUM](CR)**

Invalid Command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)
V	LED configuration For the I-7013D 1: the temperature is shown on the LED display in the data format specified by the %AANNTTCCFF command. 2: the LED display is controlled by the host. For the I-7033D and M-7033D 0~2: specifies the channel for which the temperature is shown on the LED display in the data format specified by the %AANNTTCCFF command. 3: the LED display is controlled by the host.

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: $018 Response: !011
Reads the LED configuration of module 01.
Command: $028 Response: !012
Reads the LED configuration of module 02.

Related Commands:

Section 2.17 $AA8V, Section 2.18 $AA9(Data)

Notes:

This command is only applicable to the I-7013D, I-7033D and M-7033D.

2.17 $AA8V

Description:

Sets the LED configuration of a module.

Syntax:

$AA8V[CHKSUM](CR)

$	Delimiter character
AA	Address of the module to be set (00 to FF)
8	Command to set the LED configuration
V	LED configuration For the I-7013D 1: the temperature is shown on the LED display in the data format specified by the %AANNTTCCFF command. 2: the LED display is controlled by the host. For the I-7033D and M-7033D 0~2: specifies the channel for which the temperature is shown on the LED display in the data format specified by the %AANNTTCCFF command. 3: the LED display is controlled by the host.

Response:

Valid Command: **!AA[CHKSUM](CR)**

Invalid Command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: $0180 Response: !01

Sets the LED configuration of module 01 to 0, and returns a valid response.

Command: $0281 Response: !02

Sets the LED configuration of module 02 to 1, and returns a valid response.

Related Commands:

Section 2.16 $AA8, Section 2.18 $AA9(Data)

Notes:

This command is only applicable to the I-7013D, I-7033D and M-7033D.

2.18 $AA9(Data)

Description:

Sends the data to be shown on the LED display of a module.

Syntax:

$AA9(Data)[CHKSUM](CR)

$	Delimiter character
AA	Address of the module (00 to FF)
9	Command to send the LED data
(Data)	Data to be shown on the LED display, consisting of a leading sign character (+, -), 5 decimal digits and a dot character. The first digit should be 0 or 1. There must be a digit preceding the dot character. The module should be in host controlled mode before sending this command. See Section 2.17 for details.

Response:

Valid command: **!AA[CHKSUM](CR)**

Invalid command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command, or if the module is not in host controlled mode. See Section 2.17 for details.
AA	Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: $019+123.45 Response: !01

The host sends the data "+123.45" to module 01. The module returns a valid response and shows the data on the LED display.

Command: $029+12.345 Response: ?02

The host sends the data "+12.345" to module 02. The module returns an invalid command because it is not in host controlled mode and the LED data cannot be received from the host. See Section 2.17 for details.

Related Commands:

Section 2.16 $AA8, Section 2.17 $AA8V

Notes:

This command is only applicable to the I-7013D, I-7033D and M-7033D.

2.19 $AAB

Description:

Diagnoses the analog inputs for over-range, under-range, and wire opening conditions.

Syntax:

$AAB[CHKSUM](CR)

$	Delimiter character
AA	Address of the module to be diagnosed (00 to FF)
B	Command to diagnose the analog inputs

Response:

Valid command: **!AANN[CHKSUM](CR)**

Invalid command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)
NN	Represents the diagnostic results of all the analog input channels (00 to FF), where bit 0 corresponds to channel 0, bit 1 corresponds to channel 1, etc. When the bit is 1 it denotes that the channel is enabled and it is in either over-range, under-range or wire opening condition. If the bit is 0 it denotes that the channel is disabled or normal.

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: $01B Response: !0101

Diagnoses the analog inputs of module 01. The module returns a valid response denoting that channel 0 is in either over-range, under-range or wire opening condition.

Notes:

This command is only applicable to the I-7015/15P and M-7015/15P.

2.20 $AAF

Description:

Reads the firmware version of a module.

Syntax:

$AAF[CHKSUM](CR)

$	Delimiter character
AA	Address of the module to be read (00 to FF)
F	Command to read the firmware version

Response:

Valid command: **!AA(Data)[CHKSUM](CR)**
Invalid command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)
(Data)	Firmware version string of the module

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: $01F Response: !01A2.0

Reads the firmware version of module 01, and shows that it is version A2.0.

Command: $02F Response: !02B1.1

Reads the firmware version of module 02, and shows that it is version B1.1.

2.21 $AAI

Description:

Reads the INIT terminal status of a module.

Syntax:

$AAI[CHKSUM](CR)

$	Delimiter character
AA	Address of the module to be read (00 to FF)
I	Command to read the module INIT status

Response:

Valid command: **!AAS[CHKSUM](CR)**
Invalid command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)
S	INIT terminal status of the module 0: The INIT terminal is connected to the GND terminal 1: The INIT terminal is not connected to the GND terminal

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: $01I Response: !010

Reads the INIT status of module 01. The response shows that the INIT terminal is connected to the GND terminal.

2.22 $AAM

Description:

Reads the name of a module.

Syntax:

$AAM[CHKSUM](CR)

$	Delimiter character
AA	Address of the module to be read (00 to FF)
M	Command to read the module name

Response:

Valid command: **!AA(Data)[CHKSUM](CR)**
Invalid command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)
(Name)	Name string of the module

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: $01M Response: !017013

Reads the module name of module 01 and returns the name “7013”.

Related Commands:

Section 2.31 ~AAO(Name)

2.23 $AAP

Description:

Reads the communication protocol information.

Syntax:

$AAP[CHKSUM](CR)

$	Delimiter character
AA	Address of the module to be read (00 to FF)
P	Command to read the communication protocol

Response:

Valid Response: !AASC[CHKSUM](CR)
Invalid Response: ?AA[CHKSUM](CR)

!	Delimiter character for a valid response
?	Delimiter character for an invalid response
AA	Address of the responding module (00 to FF)
S	The protocols supported by the module 0: only DCON protocol is supported 1: both the DCON and Modbus RTU protocols are supported
C	Current protocol saved in EEPROM that will be used at the next power on reset 0: the protocol set in EEPROM is DCON 1: the protocol set in EEPROM is Modbus RTU

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: $01P Response: !0110

Reads the communication protocol of module 01 and returns a response of 10 meaning that it supports both the DCON and Modbus RTU protocols and the protocol that will be used at the next power on reset is DCON.

Related Commands:

Section 2.24 $AAPN

Note:

This command is only applicable to the M-7015, M-7015P, M-7033 and M-7033D.

2.24 $AAPN

Description:

Sets the communication protocol.

Syntax:

$AAPN[CHKSUM](CR)

$	Delimiter character
AA	Address of the module to be read (00 to FF)
P	Command to set the communication protocol
N	0: DCON protocol 1: Modbus RTU protocol Before using this command, the rear slide switch must be in the INIT position for M-7015/15P, or the INIT * terminal should be connected to the GND terminal for M-7033/33D, see Section A.1 for details. The new protocol is saved in the EEPROM and will be effective after the next power on reset.

Response:

Valid Response: !AA[CHKSUM](CR)
Invalid Response: ?AA[CHKSUM](CR)

!	Delimiter character for a valid response
?	Delimiter character for an invalid response
AA	Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: $01P1 Response: ?01

Sets the communication protocol of module 01 to Modbus RTU and returns an invalid response because the module is not in INIT mode.

Command: $01P1 Response: !01

Sets the communication protocol of module 01 to Modbus RTU and returns a valid response.

Related Commands:

Section 2.23 $AAP

Related Topics:

Section A.1 INIT Mode

Note:

This command is only applicable to the M-7015, M-7015P, M-7033 and M-7033D.

2.25 $AAS0

Description:

Performs an internal calibration on a module.

Syntax:

$AAS0[CHKSUM](CR)

$ Delimiter character
AA Address of the module to be calibrated (00 to FF)
S0 Command to perform the internal calibration

Response:

Valid command: **!AA[CHKSUM](CR)**
Invalid command: **?AA[CHKSUM](CR)**
! Delimiter character for a valid command
? Delimiter character for an invalid command
AA Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: $01S0 Response: !01

Sends the command to perform an internal calibration on module 01 and returns a valid response.

Related Commands:

Section 2.26 $AAS1

Notes:

This command is only applicable to the I-7015, I-7015P, M-7015 and M-7015P.

2.26 $AAS1

Description:

Reloads the factory default calibration parameters, including the internal calibration parameters.

Syntax:

$AAS1[CHKSUM](CR)

$	Delimiter character
AA	Address of the module to have the default parameters reloaded (00 to FF)
S1	Command to reload the factory default calibration parameters

Response:

Valid command: **!AA[CHKSUM](CR)**
Invalid command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: $01S1 Response: !01

Sends the command to reload the factory default calibration parameters for module 01 and returns a valid response.

Related Commands:
Section 2.25 $AAS0

Related Topics:
Section 1.9 Calibration

Notes:
This command is only applicable to the I-7015, I-7015P, M-7015 and M-7015P.

2.27 ~AAD

Description:

Reads the miscellaneous settings of a module.

Syntax:

~AAD[CHKSUM](CR)

~ Delimiter character
AA Address of the module to be read (00 to FF)
D Command to read the miscellaneous settings

Response:

Valid Command: **!AAT[CHKSUM](CR)**
Invalid Command: **?AA[CHKSUM](CR)**

! Delimiter character for a valid command
? Delimiter character for an invalid command
AA Address of the responding module (00 to FF)
VV Two hexadecimal digits that represent the miscellaneous settings as follows:

7	6	5	4	3	2	1	0
Reserved				SU	SR	Reserved	

Key	Description
SR	Setting for over range/under range reading (for 7013/33)

Setting	Data Format	Over Range	Under Range
0	Engineering	+9999	-0000
	% of FSR	+9999	-0000
	Hex	7FFF	8000
1	Engineering	+9999.9	-9999.9
	% of FSR	+999.99	-999.99
	Hex	7FFF	8000

SU	Setting for under range reading (for 7015/15P)	
	0	The reading of under range is as usual
	1	Force the reading of under range to be the same as over range

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: ~01D Response: !0104

Reads the miscellaneous settings of module 01 and returns 04.

Related Commands:

Section 2.28 ~AADVV

Notes:

This command is only applicable to the I-7013 and I-7033/33D firmware B1.3 and later, I-7015 and M-7015 firmware B2.1 and later, I-7015P, M-7015P and M-7033/33D.

2.28 ~AADVV

Description:

Sets the miscellaneous settings of a module.

Syntax:

~AADVV[CHKSUM](CR)

~ Delimiter character

AA Address of the module to be set (00 to FF)

D Command to set the miscellaneous settings

VV Two hexadecimal digits that represent the miscellaneous settings as follows:

7	6	5	4	3	2	1	0
Reserved				SU	SR	Reserved	

Key	Description
SR	Setting for over range/under range reading (for 7013/33)
SU	Setting for under range reading (for 7015/15P)

Setting	Data Format	Over Range	Under Range
0	Engineering	+9999	-0000
	% of FSR	+9999	-0000
	Hex	7FFF	8000
1	Engineering	+9999.9	-9999.9
	% of FSR	+999.99	-999.99
	Hex	7FFF	8000

0	The reading of under range is as usual
1	Force the reading of under range to be the same as over range

Response:

Valid Command: **!AA[CHKSUM](CR)**
Invalid Command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: ~01D04 Response: !01

Sets the miscellaneous settings of module 01 to 04, and returns a valid response.

Related Commands:

Section 2.27 ~AAD

Notes:

This command is only applicable to the I-7013 and I-7033/33D firmware B1.3 and later, I-7015 and M-7015 firmware B2.1 and later, I-7015P, M-7015P and M-7033/33D.

2.29 ~AAEV

Description:

Enables/Disables the module calibration.

Syntax:

~AAEV[CHKSUM](CR)

~	Delimiter character
AA	Address of the module to be enabled/disabled (00 to FF)
E	Command to enable/disable calibration
V	1: enable calibration 0: disable calibration

Response:

Valid Command: **!AA[CHKSUM](CR)**
Invalid Command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: $010 Response: ?01

Sends the command to perform a span calibration on module 01. An invalid response is returned because the "enable calibration" command has not yet been sent.

Command: ~01E1 Response: !01

Enables calibration on module 01 and returns a valid response.

Command: $010 Response: !01

Sends the command to perform a span calibration on module 01 and returns a valid response.

Related Commands:

Section 2.5 $AA0, Section 2.6 $AA1, Section 2.7 $AA0Ci, Section 2.8 $AA1Ci

Related Topics:

Section 1.9 Calibration

2.30 ~AAI (Soft INIT command)

Description:

The Soft INIT command is used to enable modification of the Baud Rate and checksum settings using software only.

Syntax:

~AAI[CHKSUM](CR)

~	Delimiter character
AA	Address of the module to be set (00 to FF)
I	Command to set the Soft INIT

Response:

Valid command: **!AA[CHKSUM](CR)**
Invalid command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: ~01I Response: !01

Sets the soft INIT of module 01 and returns a valid response.

Related Commands:

Section 2.1 %AANNTTCCFF, Section 2.32 ~AATnn

Related Topics:

Section A.1 INIT* Pin Operation

Notes:

1. This command is only applicable to the I-7015, I-7015P, M-7015 and M-7015P.
2. The ~AATnn command should be sent prior to sending this command, see Section 2.32 for details.

2.31 ~AAO(Name)

Description:

Sets the name of a module.

Syntax:

~AAO(Name)[CHKSUM](CR)

~	Delimiter character
AA	Address of the module to be set (00 to FF)
O	Command to set the module name
(Name)	New name of the module (max. 6 characters).

Response:

Valid command: **!AA[CHKSUM](CR)**
Invalid command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: ~01O7013N Response: !01

Sets the name of module 01 to be “7013N” and returns a valid response.

Command: $01M Response: !017013N

Reads the name of module 01 and returns the name “7013N”.

Related Commands:

Section 2.22 $AAM

2.32 ~AATnn

Description:

Sets the soft INIT timeout value.

Syntax:

~AATnn[CHKSUM](CR)

~	Delimiter character
AA	Address of the module to be set (00 to FF)
T	Command to set the soft INIT timeout
nn	Two hexadecimal digits representing the timeout value in seconds. The maximum timeout value is 60 seconds. When changing the Baud Rate or checksum settings without altering the INIT* pin, the ~AAI and %AANNTTCCFF commands should be sent consecutively and the time interval between the two commands should be less than the soft INIT timeout. If the soft INIT timeout is 0, then the Baud Rate and checksum settings cannot be changed using software only. The power-on reset value of the soft INIT timeout is 0.

Response:

Valid command: **!AA[CHKSUM](CR)**
Invalid command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: ~01I Response: !01

Sets the soft INIT timeout value of module 01 and returns a valid response.

Command: %0101000700 Response: ?01

Attempts to change the Baud Rate of module 01 to 19200 without first altering the INIT * pin. The module returns an invalid response because the soft INIT timeout value is 0.

Command: ~01T10 Response: !01

Sets the soft INIT timeout value of module 01 to 16 seconds and returns a valid response.

Command: ~01I Response: !01

Sets the soft INIT of module 01 and returns a valid response.

Command: %0101000700 Response: !01

Changes the Baud Rate of module 01 to 19200 without first altering INIT * pin. The module returns a valid response.

Related Commands:

Section 2.1 %AANNTTCCFF, Section 2.30 ~AAI

Related Topics:

Section A.1 INIT* Pin Operation

Notes:

1. This command is only applicable to the I-7015, I-7015P, M-7015 and M-7015P.
2. It is recommended that the soft INIT timeout value is reset to 0 once any changes to the Baud Rate and checksum settings have been completed.

2.33 ~**

Description:

Informs all modules that the host is OK.

Syntax:

~[CHKSUM](CR)**

~ Delimiter character

** Host OK command

Response:

No response.

Examples:

Command: ~** No response

Sends a "Host OK" command to all modules.

Related Commands:

Section 2.34 ~AA0, Section 2.35 ~AA1, Section 2.36 ~AA2, Section 2.37 ~AA3EVV

Related Topics:

Section A.2 Dual Watchdog Operation

2.34 ~AA0

Description:

Reads the host watchdog status of a module.

Syntax:

~AA0[CHKSUM](CR)

~	Delimiter character
AA	Address of the module to be read (00 to FF)
0	Command to read the module status

Response:

Valid command: **!AASS[CHKSUM](CR)**
Invalid command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)
SS	Two hexadecimal digits that represent the host watchdog status, where: Bit 7: 0 indicates that the host watchdog is disabled, and 1 indicates that the host watchdog is enabled, Bit 2: 1 indicates that a host watchdog timeout has occurred, and 0 indicates that no host watchdog timeout has occurred. The host watchdog status is stored in EEPROM and can only be reset by using the ~AA1 command.

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: ~010 Response: !0100

Reads the host watchdog status of module 01 and returns 00, meaning that the host watchdog is disabled and no host watchdog timeout has occurred.

Command: ~020 Response: !0204

Reads the host watchdog status of module 02 and returns 04, meaning that a host watchdog timeout has occurred.

Related Commands:

Section 2.33 ~**, Section 2.35 ~AA1, Section 2.36 ~AA2, Sec 2.37 ~AA3EVV

Related Topics:

Section A.2 Dual Watchdog Operation

2.35 ~AA1

Description:

Resets the host watchdog timeout status of a module.

Syntax:

~AA1[CHKSUM](CR)

~	Delimiter character
AA	Address of the module to be reset (00 to FF)
1	Command to reset the host watchdog timeout status

Response:

Valid command: **!AA[CHKSUM](CR)**
Invalid command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: ~010 Response: !0104

Reads the host watchdog status of module 01 and shows that a host watchdog timeout has occurred.

Command: ~011 Response: !01

Resets the host watchdog timeout status of module 01 and returns a valid response.

Command: ~010 Response: !0100

Reads the host watchdog status of module 01 and shows that no host watchdog timeout has occurred.

Related Commands:

Section 2.33 ~**, Section 2.34 ~AA0, Section 2.36~AA2, Section 2.37~AA3EVV

Related Topics:

Section A.2 Dual Watchdog Operation

2.36 ~AA2

Description:

Reads the host watchdog timeout value of a module.

Syntax:

~AA2[CHKSUM](CR)

~	Delimiter character
AA	Address of the module to be read (00 to FF)
2	Command to read the host watchdog timeout value

Response:

Valid command : **!AAEVV[CHKSUM](CR)**
Invalid command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)
E	1: the host watchdog is enabled 0: the host watchdog is disabled
VV	Two hexadecimal digits to represent the timeout value in tenths of a second, for example, 01 denotes 0.1 seconds and FF denotes 25.5 seconds.

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: ~012 Response: !011FF

Reads the host watchdog timeout value of module 01 and returns FF, which denotes that the host watchdog is enabled and the host watchdog timeout value is 25.5 seconds.

Related Commands:

Section 2.33 ~**, Section 2.34 ~AA0, Section 2.35 ~AA1, Section 2.37 ~AA3EVV

Related Topics:

Section A.2 Dual Watchdog Operation

2.37 ~AA3EVV

Description:

Enables/disables the host watchdog and sets the host watchdog timeout value of a module.

Syntax:

~AA3EVV[CHKSUM](CR)

~	Delimiter character
AA	Address of the module to be set (00 to FF)
3	Command to set the host watchdog
E	1: enable the host watchdog 0: disable the host watchdog
VV	Two hexadecimal digits to represent the timeout value in tenths of a second, for example, 01 denotes 0.1 seconds and FF denotes 25.5 seconds.

Response:

Valid command: **!AA[CHKSUM](CR)**
Invalid command: **?AA[CHKSUM](CR)**

!	Delimiter character for a valid command
?	Delimiter character for an invalid command
AA	Address of the responding module (00 to FF)

There will be no response if the command syntax is incorrect, there is a communication error, or there is no module with the specified address.

Examples:

Command: ~013164 Response: !01

Enables the host watchdog of module 01 and sets the host watchdog timeout value to 10.0 seconds. The module returns a valid response.

Command: ~012 Response: !01164

Reads the host watchdog timeout value of module 01. The module returns 164, which denotes that the host watchdog is enabled and the host watchdog timeout value is 10.0 seconds.

Related Commands:

Section 2.33 ~**, Section 2.34 ~AA0, Section 2.35 ~AA1, Section 2.36 ~AA2

Related Topics:

Section A.2 Dual Watchdog Operation

Notes:

When a host watchdog timeout occurs, the host watchdog is disabled. The ~AA3EVV command should be sent again to re-enable the host watchdog.

3. Modbus RTU Protocol

The Modbus protocol is developed by Modicon Inc., originally developed for Modicon controllers. Detailed information can be found at http://www.modicon.com/techpubs/toc7.html. You can also visit http://www.modbus.org to find more valuable information.

M-7000 series modules support the Modbus RTU protocol. The communication Baud Rates range from 1200bps to 115200bps. The number of data bits is fixed to 8. For M-7015/15P firmware version B202 and later, the parity can be none, even or odd. For M-7015/15P other versions and M-7033/33D, the parity and stop bits are fixed as no parity and 1 stop bit. The following Modbus functions are supported.

Function Code	Description	Section
02 (0x02)	Read input status	3.1
04 (0x04)	Read input channels	3.2
70 (0x46)	Read/write module settings	3.3

Note: Function 02 is used to read the RTD wire opening status and is only supported by the M-7015/15P.

If the function specified in the message is not supported, then the module responds as follows.

Error Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	Function code | 0x80
02	Exception code	1 Byte	01

If a CRC mismatch occurs, the module will not respond.

3.1 02 (0x02) Read Input Status

This function code is used to read the RTD wire opening status of a module.

Request

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x02
02 ~ 03	Starting channel	2 Bytes	0x80 to 0x85, where 0x80 corresponds to channel 0, 0x81 corresponds to channel 1, etc
04 ~ 05	Number of input channels	2 Bytes	N, 1 to 6; (Starting channel + N) should be less than or equal to 0x86

Note: This function is only available to the M-7015/15P.

Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x02
02	Byte count	1 Byte	1
03	Data of input channels	1 Byte	A bit corresponds to a channel. When the bit is 1 it denotes that the channel is enabled and is either over-range, under-range or wire opening. If the bit is 0 it denotes that the channel is disabled or normal.

Error Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x82
02	Exception code	1 Byte	02: starting channel out of range 03: (starting channel + number of input channels) out of range, incorrect number of bytes received

3.2 04 (0x04) Read Input Channels

This function code is used to read from contiguous analog input channels.

Request

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x04
02 ~ 03	Starting channel	2 Bytes	0 to 2 for M-7033/33D 0 to 5 for M-7015
04 ~ 05	Number of input channels (N)	2 Bytes	1 to 3; (Starting channel + N) <= 3 for M-7033/33D. 1 to 6; (Starting channel + N) <= 6 for M-7015/15P.

Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x04
02	Byte count	1 Byte	2 x N
03 ~	Data of input channels	2 x N Bytes	Data in 2's complement hex format.

Error Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x84
02	Exception code	1 Byte	02: starting channel out of range 03: (starting channel + number of input channels) out of range, incorrect number of bytes received

3.3 70 (0x46) Read/Write Module Settings

This function code is used to read the settings of the module or change the settings of the module. The following sub-function codes are supported.

Sub-function Code	Description	Section
00 (0x00)	Read the module name	3.3.1
04 (0x04)	Set the module address	3.3.2
05 (0x05)	Read the communication settings	3.3.3
06 (0x06)	Set the communication settings	3.3.4
07 (0x07)	Read the type code	3.3.5
08 (0x08)	Set the type code	3.3.6
32 (0x20)	Read the firmware version	3.3.7
37 (0x25)	Read the channel enable/disable status	3.3.8
38 (0x26)	Set the channel enable/disable	3.3.9
41 (0x29)	Read the miscellaneous settings	3.3.10
42 (0x2A)	Write the miscellaneous settings	3.3.11
49 (0x31)	Read the LED configuration	3.3.12
50 (0x32)	Write the LED configuration	3.3.13

If the module does not support the sub-function code specified in the message, then it responds as follows.

Error Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0xC6
02	Exception code	1 Byte	02: invalid sub-function code

3.3.1 Sub-function 00 (0x00) Read module name

This sub-function code is used to read the name of a module.

Request

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x00

Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x00
03 ~ 06	Module name	4 Bytes	0x00 0x70 0x15 0x00 for M-7015 0x00 0x70 0x15 0x20 for M-7015P 0x00 0x70 0x33 0x00 for M-7033 0x00 0x70 0x33 0x14 for M-7033D

Error Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0xC6
02	Exception code	1 Byte	03: incorrect number of bytes received

3.3.2 Sub-function 04 (0x04) Set module address

This sub-function code is used to set the address of a module.

Request

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x04
03	New address	1 Byte	1 to 247
04 ~ 06	Reserved	3 Bytes	0x00 0x00 0x00

Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x04
03	Set address result	1 Byte	0: OK, others: error
04 ~ 06	Reserved	3 Bytes	0x00 0x00 0x00

Error Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0xC6
02	Exception code	1 Byte	03: new address out of range, reserved bytes should be filled with zero, incorrect number of bytes received

3.3.3 Sub-function 05 (0x05) Read communication settings

This sub-function code is used to read the communication protocol settings of a module.

Request

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x05
03	Reserved	1 Byte	0x00

Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x05
03	Reserved	1 Byte	0x00
04	Baud Rate	1 Byte	0x03 ~ 0x0A, Baud Rate code, see Section 1.10 for details.
05	Reserved	1 Byte	0x00
06	Parity	1 Byte	For M-7015/15P firmware version B2.2 and later 0x00: no parity, 1 stop bit 0x01: no parity, 2 stop bits 0x02: even parity, 1 stop bit 0x03: odd parity, 1 stop bit Reserved for other modules or firmware version and should be zero
07	Reserved	1 Byte	0x00
08	Mode	1 Byte	0: DCON protocol 1: Modubs RTU protocol
09 ~ 10	Reserved	2 Bytes	0x00 0x00

Note: This information is the data saved in the EEPROM and will be used for the next power-on reset. It is not the currently used settings.

Error Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0xC6
02	Exception code	1 Byte	03: reserved byte should be filled with zero, incorrect number of bytes received

3.3.4 Sub-function 06 (0x06) Set communication settings

This sub-function code is used to set the communication protocol of a module.

Request

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x06
03	Reserved	1 Byte	0x00
04	Baud Rate	1 Byte	0x03 ~ 0x0A, Baud Rate code, see Section 1.10 for details.
05	Reserved	1 Byte	0x00
06	Parity	1 Byte	For M-7015/15P firmware version B2.2 and later 0x00: no parity, 1 stop bit 0x01: no parity, 2 stop bits 0x02: even parity, 1 stop bit 0x03: odd parity, 1 stop bit Reserved for other modules or firmware version and should be zero
07	Reserved	1 Byte	0x00
08	Mode	1 Byte	0: DCON protocol 1: Modubs RTU protocol
09 ~ 10	Reserved	2 Bytes	0x00 0x00

Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x06
03	Reserved	1 Byte	0x00
04	Baud Rate	1 Byte	0: OK, others: error
05	Reserved	1 Byte	0x00
06	Parity	1 Byte	0: OK, others: error
07	Reserved	1 Byte	0x00
08	Mode	1 Byte	0: OK, others: error
09 ~ 10	Reserved	2 Bytes	0x00 0x00

Note: The new Baud Rate and protocol will be effective after the next power-on reset.

Error Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0xC6
02	Exception code	1 Byte	03: Baud Rate or mode out of range, reserved bytes should be filled with zero, incorrect number of bytes received

3.3.5 Sub-function 07 (0x07) Read type code

This sub-function code is used to read the type code information of a module.

Request

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x07
03	Reserved	1 Bytes	0x00
04	Channel	1 Byte	0x00 ~ 0x05 for M-7015/15P 0x00 for M-7033/33D

Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x07
03	Type code	1 Byte	Type code, see Section 1.10 for details.

Error Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0xC6
02	Exception code	1 Byte	03: reserved bytes should be filled with zero, channel out of range for M-7015/15P, incorrect number of bytes received

3.3.6 Sub-function 08 (0x08) Set type code

This sub-function code is used to set the type code of a module.

Request

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x08
03	Reserved	1 Byte	0x00
04	Channel	1 Byte	0x00 ~ 0x05 for M-7015/15P 0x00 for M-7033/33D
05	Type code	1 Byte	Type code, see Section 1.10 for details.

Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x08
03	Type code	1 Byte	0: OK others: error

Error Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0xC6
02	Exception code	1 Byte	03: type code out of range, channel out of range for M-7015/15P, reserved bytes should be filled with zero, incorrect number of bytes received

3.3.7 Sub-function 32 (0x20) Read firmware version

This sub-function code is used to read the firmware version information of a module.

Request

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x20

Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x20
03	Major version	1 Byte	0x00 ~ 0xFF
04	Minor version	1 Byte	0x00 ~ 0xFF
05	Build version	1 Byte	0x00 ~ 0xFF

Error Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0xC6
02	Exception code	1 Byte	03: incorrect number of bytes received

3.3.8 Sub-function 37 (0x25) Read channel enabled/disabled status

This sub-function code is used to read the enabled/disabled status of each channel in a module.

Request

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x25

Note: This sub-function is only applicable to the M-7015/15P.

Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x25
03	Enabled/disabled status	1 Byte	0x00 ~ 0x3F, enabled/disabled status of each channel, where bit 0 corresponds to channel 0, bit 1 corresponds to channel 1, etc. When the bit is 1 it denotes that the channel is enabled and 0 denotes that the channel is disabled.

Error Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0xC6
02	Exception code	1 Byte	03: incorrect number of bytes received

3.3.9 Sub-function 38 (0x26) Set channel enable/disable

This sub-function code is used to specify the channels to be enabled in a module.

Request

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x26
03	Enable/disable setting	1 Byte	0x00 ~ 0x3F, enable/disable setting of each channel, where bit 0 corresponds to channel 0, bit 1 corresponds to channel 1, etc. When the bit is 1 it denotes that the channel is enabled and 0 denotes that the channel is disabled.

Note: This sub-function is only applicable to the M-7015/15P.

Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x26
03	Enable/disable setting	1 Byte	0: OK others: error.

Error Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0xC6
02	Exception code	1 Byte	03: enable/disable setting out of range, incorrect number of bytes received

3.3.10 Sub-function 41 (0x29) Read miscellaneous settings

This sub-function code is used to read the miscellaneous settings of a module.

Request

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x29

Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x29
03	Miscellaneous settings	1 Byte	Bit 7: filter setting, reserved for M-7015 firmware version A2.9 and before 0: 60Hz rejection 1: 50Hz rejection Bit 6~0: reserved

Note: The reserved fields are filled with zeros.

Error Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0xC6
02	Exception code	1 Byte	03: incorrect number of bytes received

3.3.11 Sub-function 42 (0x2A) Write miscellaneous settings

This sub-function code is used to set the miscellaneous settings of a module.

Request

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x2A
03	Miscellaneous settings	1 Byte	Bit 7: filter setting, reserved for M-7015 firmware version A2.9 and before 0: 60Hz rejection 1: 50Hz rejection Bit 6~0: reserved

Note: The reserved fields are filled with zeros.

Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x2A
03	Miscellaneous settings	1 Byte	0: OK others: error

Error Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0xC6
02	Exception code	1 Byte	03: reserved bits should be filled with zero, incorrect number of bytes received

3.3.12 Sub-function 49 (0x31) Read LED configuration

This sub-function code is used to read the LED configuration setting of a module.

Request

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x31

Note: This sub-function is only applicable to the M-7033D.

Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x31
03	Channel	1 Byte	0x00 ~ 0x02, the channel for which the data is shown on the LED display
04	Data format	1 Byte	The data format to show the data on the LED display 0x00: Engineering unit 0x01: % of FSR 0x02: 2's complement hexadecimal 0x03: Ohms

Error Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0xC6
02	Exception code	1 Byte	03: incorrect number of bytes received

3.3.13 Sub-function 50 (0x32) Write LED configuration

This sub-function code is used to set the LED configuration setting of a module.

Request

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x32
03	Channel	1 Byte	0x00 ~ 0x02, the channel for which the data is shown on the LED display
04	Data format	1 Byte	The data format to show the data on the LED display 0x00: Engineering unit 0x01: % of FSR 0x02: 2's complement hexadecimal 0x03: Ohms

Note: This sub-function is only applicable to the M-7033D.

Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0x46
02	Sub function code	1 Byte	0x32
03	Miscellaneous settings	1 Byte	0: OK others: error

Error Response

00	Address	1 Byte	1 to 247
01	Function code	1 Byte	0xC6
02	Exception code	1 Byte	03: channel out of range, incorrect data format, incorrect number of bytes received

3.4 M-7015/15P Address Mappings

For M-7015/15P firmware version B202 and later, the address mappings are as follows.

<table>
<tr><th>Address</th><th>Description</th><th>Attribute</th></tr>
<tr><td>10129 ~ 10134
00129 ~ 00134</td><td>Over/under range status of channel 0 to 5</td><td>R</td></tr>
<tr><td>30001 ~ 30006
40001 ~ 40006</td><td>Analog input value of channel 0 to 5</td><td>R</td></tr>
<tr><td>40257 ~ 40262</td><td>Type code of channel 0 to 5</td><td>R/W</td></tr>
<tr><td>40289 ~ 40294</td><td>Temperature offset of channel 0 to 5 in 0.1°C, valid range: -128 ~ 127</td><td>R/W</td></tr>
<tr><td>40385 ~ 40390</td><td>Resistance offset of channel 0 to 5 in 0.1 ohms, valid range: 0 ~ 255</td><td>R/W</td></tr>
<tr><td>40481</td><td>Firmware version (low word)</td><td>R</td></tr>
<tr><td>40482</td><td>Firmware version (high word)</td><td>R</td></tr>
<tr><td>40483</td><td>Module name (low word)</td><td>R</td></tr>
<tr><td>40484</td><td>Module name (high word)</td><td>R</td></tr>
<tr><td>40485</td><td>Module address, valid range: 1 ~ 247</td><td>R/W</td></tr>
<tr><td>40486</td><td>Bits 5:0
Baud rate, 0x03 ~ 0x0A
<table>
<tr><td>Code</td><td>0x03</td><td>0x04</td><td>0x05</td><td>0x06</td></tr>
<tr><td>Baud</td><td>1200</td><td>2400</td><td>4800</td><td>9600</td></tr>
<tr><td>Code</td><td>0x07</td><td>0x08</td><td>0x09</td><td>0x0A</td></tr>
<tr><td>Baud</td><td>19200</td><td>38400</td><td>57600</td><td>115200</td></tr>
</table>
Bits 7:6
00: no parity, 1 stop bit
01: no parity, 2 stop bits
10: even parity, 1 stop bit
11: odd parity, 1 stop bit</td><td>R/W</td></tr>
</table>

Address	Description	Attribute
40488	Modbus response delay time in ms, valid range: 0 ~ 30	R/W
40489	Host watchdog timeout value, 0 ~ 255, in 0.1s	R/W
40490	Channel enable/disable	R/W
40492	Host watchdog timeout count, write 0 to clear	R/W
00257	Protocol, 0: DCON, 1: Modbus RTU	R/W
00259	Filter setting, 0: 60Hz rejection, 1: 50Hz rejection	R/W
00260	Modbus host watchdog mode 0: same as I-7000 1: can use AO and DO command to clear host watchdog timeout status	R/W
00261	1: enable, 0: disable host watchdog	R/W
00269	Modbus data format, 0: hex, 1: engineering	R/W
00270	Host watch dog timeout status, write 1 to clear host watch dog timeout status	R/W
00272	Write 1 to load factory calibration parameters	W
00273	Reset status, 1: first read after powered on, 0: not the first read after powered on	R
00275	1: force to return 32767 for wire opening	R/W

Notes:

1. The max number of analog output registers written in a command is 11.
2. The command of loading factory calibration parameters takes about 3 seconds. The next command should be sent after 3 seconds.

3.5 M-7015/15P Engineering Data Format Table

For M-7015/15P firmware version B202 and later, the engineering data format for Modbus protocol is supported and the table is as follows.

Type Code	RTD Type	-F.S.	+F.S.
20	Pt 100, α = 0.00385	-10000	10000
21	Pt 100, α = 0.00385	0	10000
22	Pt 100, α = 0.00385	0	20000
23	Pt 100, α = 0.00385	0	6000
24	Pt 100, α = 0.003916	-10000	10000
25	Pt 100, α = 0.003916	0	10000
26	Pt 100, α = 0.003916	0	20000
27	Pt 100, α = 0.003916	0	6000
28	Ni 120	-8000	10000
29	Ni 120	0	10000
2A	Pt 1000, α = 0.00385	-2000	6000
2B	Cu 100, α = 0.00421	-2000	15000
2C	Cu 100, α = 0.00427	0	20000
2D	Cu 1000, α = 0.00421	-2000	15000
2E	Pt 100, α = 0.00385	-20000	20000
2F	Pt 100, α = 0.003916	-20000	20000
80	Pt 100, α = 0.00385	-2000	6000
81	Pt 100, α = 0.003916	-2000	6000
82	Cu 50	-5000	15000
83	Ni 100	-6000	18000

The under range value is –32768 and the over range value is +32767. For the hex data format, please refer to Section 1.10.

4. Troubleshooting

If you are having difficulty using the I-7000 or M-7000 module, here are some suggestions that may help. If you cannot find the answers you need in these guides, contact ICP DAS Product Support. Contact information is located in Section 1.13.

4.1 Communicating with the module

If you attempt to communicate with the module and receive no response, first check the following:

- Ensure that the supplied power is within the range of +10 to +30 V DC. If the supplied power is OK, then the power LED should be on.
- When the module receives a command, the power LED is set to “off”. The power LED is shown as “on” after the module responds. This method can be used to check whether the module has received a command sent from the host.
- If possible, use another device to check whether the host can communicate with the device through the same RS-485 network.
- If the host is a PC installed with a Windows operating system, then execute the DCON Utility to determine whether the module can be found. The DCON Utility can be downloaded from the ICP DAS website http://www.icpdas.com. The DCON Utility documentation can be found in the ”**Getting Started For I-7000 Series Modules**” manual.
- Set the module to “INIT mode” and communicate with the module using the following settings: address 00, Baud Rate 9600bps, no checksum and DCON protocol. See Section A.1 for details.

4.2 Reading Data

If the data read from the input channel is not correct, first check the following:

- Ensure that the type code and data format settings are correct. For the I-7013/13D, I-7033/33D and M-7033/33D, the type code is set by using the %AANNTTCCFF command, see Section 2.1 for details. For the I-7015/15P and M-7015/15P, the type code is set by using the $AA7CiRrr command, see Section 2.14 for details. The data format is set by using the %AANNTTCCFF command. For the Modbus RTU protocol, the type code is set by using sub-function 08h of the function 46h.
- Connect a resistor, instead of the RTD sensor, using the 2-wire RTD connection as shown in Section 1.6. The resistance of the resistor should be within the range shown in the RTD Type and Data Format Table in Section 1.10. For example, if the type code is set to 20, then the resistance should be larger than 60.6 ohms and less than 138.5 ohms. Change the data format to ohms, see Sections 1.10 and 2.1, and check whether the data reading is correct. For M-7015/15P and M-7033/33D, this should be performed with DCON protocol.
- If the resistance read by the module is still incorrect, then it may be because the calibration parameters stored in the non-volatile memory are corrupted, which means that the module should be recalibrated. Be sure to read Section 1.9 in detail before performing the calibration. For the I-7015/15P and M-7015/15P, you can send the $AAS1 DCON command, see Section 2.26 for details, to reload the factory calibration parameters.

A. Appendix

A.1 INIT Mode

Each I-7000 and M-7000 module has a built-in EEPROM to store configuration information such as module address, type code, Baud Rate, etc. Occasionally, the configuration of a module may be forgotten and there are no visual indications of the configuration of the module. It is difficult to communicate with the module when the configuration of the module is unknown. To help avoid this problem, the I-7000 and M-7000 series has a special mode called **"INIT mode"**. When the module is powered on in **"INIT mode"** the configuration of the module is reset as follows, allowing it to be operated as normal.

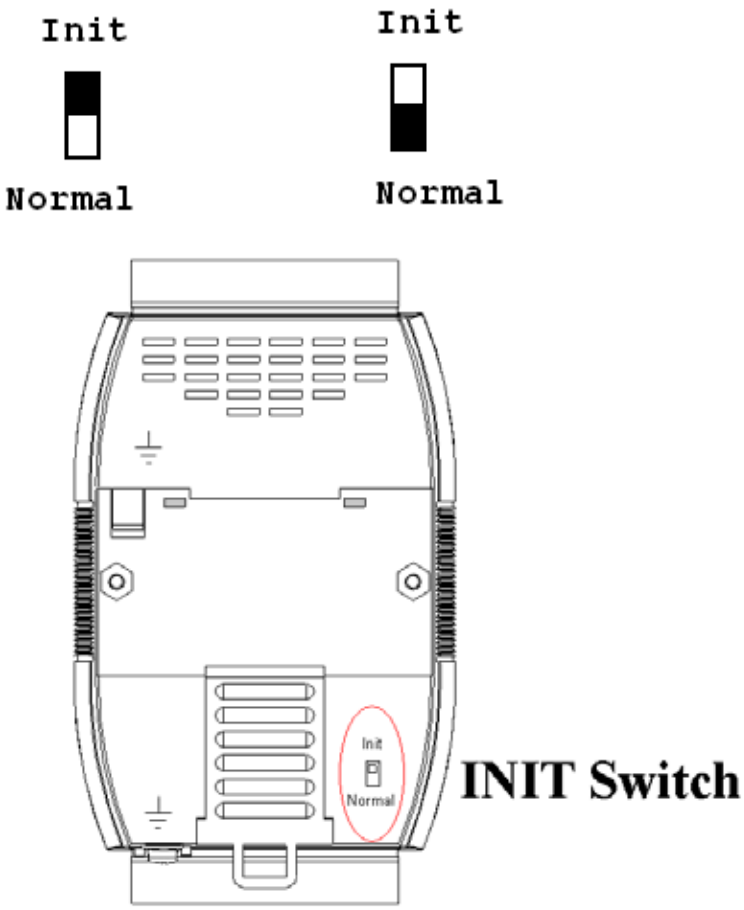
1. Address: 00
2. Baud Rate: 9600 bps
3. No checksum
4. Protocol: DCON

The configuration information stored in the EEPROM is not changed and can be read by sending the $002(CR) command at 9600bps.

There are commands that require the module to be in INIT mode. They are:

1. %AANNTTCCFF when changing Baud Rate and checksum settings. See Section 2.1 for details.
2. $AAPN, see Section 2.24 for details.

Originally, the INIT mode is accessed by connecting the INIT* terminal to the GND terminal. New I-7000 and M-7000 modules have the INIT switch located on the rear side of the module allow easier access to the INIT mode. For these modules, INIT mode is accessed by sliding the INIT switch to the Init position as shown below.



A.2 Dual Watchdog Operation

Dual Watchdog = Module Watchdog + Host Watchdog

The Module Watchdog is a hardware reset circuit that monitors the operating status of the module. While working in harsh or noisy environments, the module may be shut down by external signals. The circuit allows the module to work continuously without disruption.

The Host Watchdog is a software function that monitors the operating status of the host. Its purpose is to prevent problems due to network/communication errors or host malfunctions. When a host watchdog timeout occurs, the module will reset all outputs to a safe state in order to prevent any erroneous operations of the controlled target.

I-7000 and M-7000 series modules include an internal Dual Watchdog, making the control system more reliable and stable.

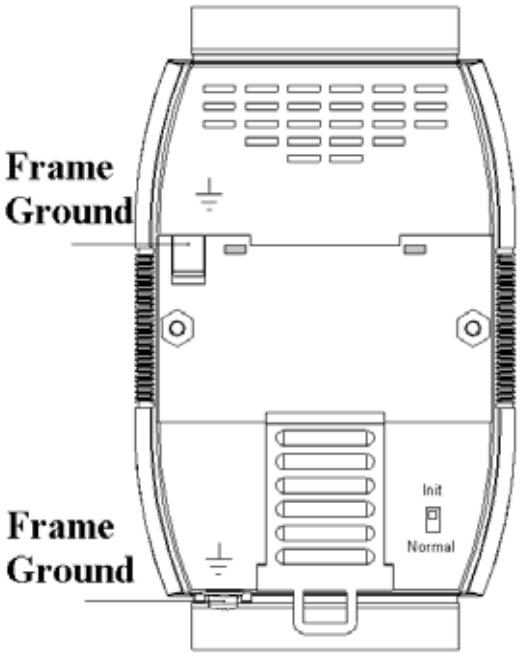
For more information regarding the Dual Watchdog, please refer to Chapter 5 of the "**Getting Started For I-7000 Series Modules**" manual that can be downloaded from the ICP DAS website http://www.icpdas.com.

A.3 Frame Ground

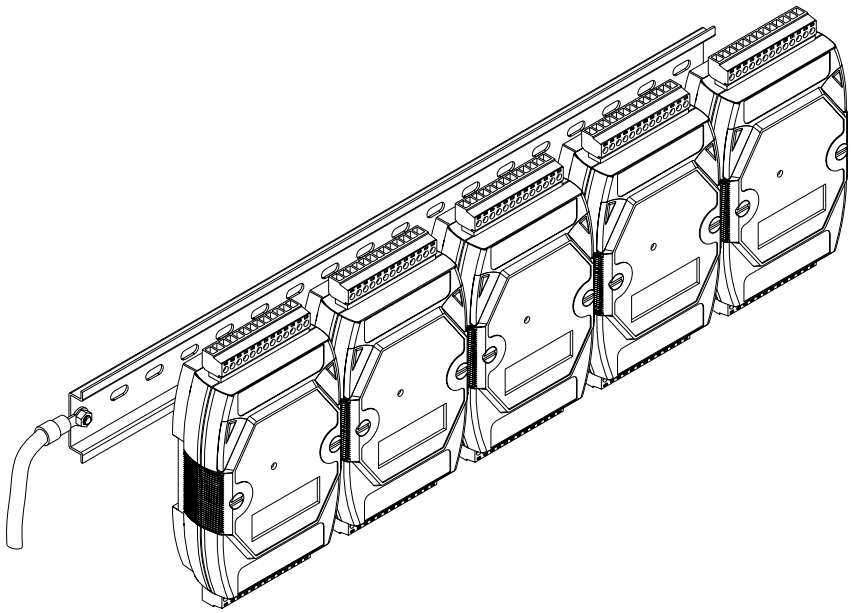
Electronic circuits are constantly vulnerable to Electro-Static Discharge (ESD), which become worse in a continental climate area. Some I-7000 and M-7000 modules feature a new design for the frame ground, which provides a path for bypassing ESD, allowing enhanced static protection (ESD) capability and ensures that the module is more reliable.

Either of the following options will provide a better protection for the module:

1. If the module is DIN rail mounted, connect the DIN rail to the earth ground because the DIN rail is in contact with the upper frame ground as shown in the figure below.
2. Alternatively, connect the lower frame ground terminal to a wire and connect the wire to the earth ground, as shown in the figure below.

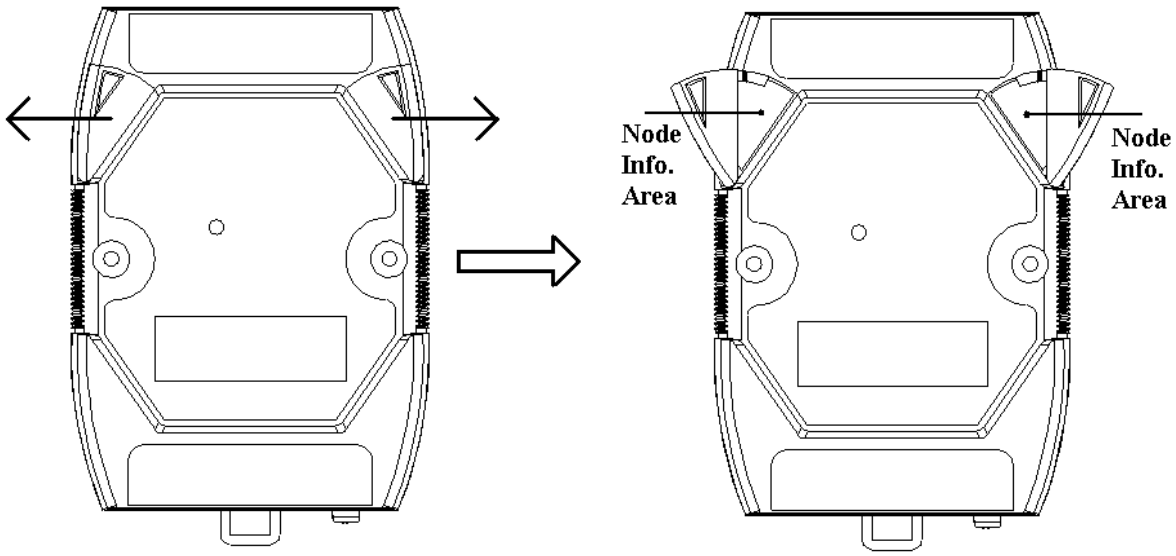


New DIN rail models are available that can easily be connected to the earth ground. Each is made of stainless steel, which is stronger than those made of aluminum. There is a screw at one end and a ring terminal is included as shown in the figure below. Refer to Section 1.12.1 for more information about the new DIN rail models.



A.4 Node Information Area

Each I-7000 and M-7000 module has a built-in EEPROM to store configuration information such as module address, type code, Baud Rate, etc. One minor drawback is that there are no visual indications of the configuration of the module. New I-7000 and M-7000 modules include node information areas that are protected by a cover, as shown below, and can be used to make a written record of the node information, such as module address, Baud Rate, etc. To access the node information areas, first slide the covers outward, as shown in the figure below.



A.5 RTD

An Resistance Temperature Detector (RTD) is a temperature detector that senses temperature by measuring the resistance of a material. For RTDs, the resistance increases as the temperature rises and the relationship can be expressed as:

$$R = R_0[1+\alpha_1(T-T_0) + \alpha_2(T-T_0)^2+\ldots+\alpha_n(T-T_0)^n]$$

where R_0 is the resistance at the reference temperature T_0. Materials used for RTDs can be gold, silver, copper or platinum. The principal advantages of RTDs are their high sensitivity, high repeatability, long-term stability and accuracy for platinum and the low cost for copper and nickel. Nickel offers a higher sensitivity but has smaller linear range than platinum and tends to drift with time. Copper has a broad linear range, but it oxidizes at moderate temperature. Platinum, with a nearly linear temperature versus resistance relationship, offers the best performance and has become the most-used metal for RTDs. The 100-ohm probe, designated as Pt100, is an industry standard. RTDs are recommended for applications where accuracy over a wide temperature range is the most important factor.

A.6 Resistance Measurement

The I-7013/13D, I-7015/15P, I-7033/33D, M-7015/15P and M-7033/33D modules can be used for resistance measurement. To measure the resistance, connect the resistor using the 2-wire RTD connection, as shown in Section 1.6, and set the data format to ohms. To set the data format, send the %AANNTTCCFF command to the module, see Section 2.1 for details, or use the DCON utility, refer to Chapter 2 of the "**Getting Started For I-7000 Series Modules**" manual that can be downloaded from the ICP DAS website http://www.icpdas.com. For M-7015/15P and M-7033/33D, it has to be switched to DCON protocol for resistance measurement.

The maximum resistances that can be measured are as follows:

For I-7013/13D:

Type Code	Maximum Resistance
82*	200 ohms
20 to 29	375 ohms
2A**	3200 ohms
*: only available with firmware version B1.5 and later **: only available with firmware version B1.3 and later	

For I-7033/33D and M-7033/33D:

Type Code	Maximum Resistance
82*	200 ohms
20 to 29	375 ohms
2A	3200 ohms
*: only available with firmware version B1.5 and later	

For I-7015/15P and M-7015/15P:

For firmware version A2.9 and before:

Type Code	Maximum Resistance
2B, 2C	160 ohms
20 to 29	320 ohms
2A, 2D	3000 ohms

For firmware version B1.9 and later:

Type Code	Maximum Resistance
2B, 2C	200 ohms
20 to 29	375 ohms
2A, 2D	3200 ohms